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CONSUMER AND CORPORATE AFFAIRS CANADA

Benefit - Cost Study of the Energuide Program

May 1984

Prepared by Peat, Marwick and Partners

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EXECUTIVE SUMMARY

STUDY TERMS OF REFERENCE

This study reports on a benefit-cost study of the Energuide program. The conduct of the benefit-cost study follows upon earlier feasibility study conducted by Peat, Marwick and Partners.

Terms of Reference

The Terms of Reference for the study are reproduced in their entirety as Annex 1 to the main report.

The two major objectives of the engagement were to:

- measure the energy saving attributable to Energuide;
- estimate costs and benefits incurred as a result of the Energuide program.

Costs and benefits were evaluated according to two timeframes, which are:

- the "past", which incorporates program activities from their commencement to 1985/86, and their past and future impacts;
- the "future", which incorporates additional impacts flowing from a program extension from 1985/86 to 1989/90.

The timeframe within which the study was completed was very short. The Terms of Reference reflect this short timeframe, particularly in the choice of the lines of inquiry which are pursued in the study.

There are several implications of this, which should be taken into account in considering the results of the study:

- The determination of energy savings requires the construction of hypothetical scenarios. One scenario has been constructed for the "past", and three for the "future". These scenarios can be assessed for reasonableness, but are, in the end, based only on informed judgement.

- The evaluation of energy savings has been based on two perspectives, providing an "upper bound" and "lower bound" estimate.

- It has not been possible to address satisfactorily some of the key elements of the total benefit/cost equation. The most important of these elements is the actual cost to the consumer and to society of incorporating energy savings features into labelled appliances. While estimates of these costs have been made, they are very preliminary.

AGGREGATE GROSS ENERGY SAVINGS

One of the two basic objectives of the study is to provide estimates of the gross energy savings attributable to the Energuide program. Exhibit S-1, opposite, summarizes the estimates derived in the study for selected years. The exhibit provides results based on both the past operation and a future extension of the program.

The results in Exhibit S-1 are presented in gigawatt-hours of energy saved per year, for the aggregate stock of appliances purchased in that year. Estimates are essentially derived by the aggregation of a large number of assumptions with respect to hypothetical behaviour. There is a relatively

EXHIBIT S-2

VALUATION OF GROSS ENERGY SAVINGS
(million 1983 $)
(10% discount rate)

	Past Program NPV in 1978		Future Program NPV in 1984					
	Base Case Energy Savings		Low Case Energy Savings		Base Case Energy Savings		High Case Energy Savings	
Appliance	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
Refrigerators	238.7	193.7	56.8	46.0	108.9	88.4	175.2	142.3
Freezers	154.7	123.8	8.3	6.6	39.1	31.2	52.1	41.5
Dishwashers	280.9	58.4	15.1	3.2	90.8	18.8	103.6	21.4
Clotheswashers	579.6	157.6	5.9	1.6	27.8	7.7	54.9	15.2
Ranges	43.5	11.0	0.0	0.0	0.0	0.0	7.7	2.5
Dryers	14.8	4.6	0.0	0.0	4.0	1.3	9.5	3.1
Total	1,312.1	549.1	86.1	57.4	270.6	147.4	403.0	226.0

SOURCE: Section VI
Appendix J

wide range of uncertainty associated with the estimates. This is dealt within Exhibit S-1 through the provision of three cases with respect to future program extension.

EVALUATION OF ENERGY SAVINGS

The gross energy savings estimates in Exhibit S-1 have been valued from two perspectives:

- A long run social cost perspective, which represents an "upper bound" estimate.
- A rate-based perspective, which represents a "lower bound" estimate.

Exhibit S-2, opposite, summarizes the results of the valuation of gross energy savings attributable to the Program. Exhibit S-3, overleaf, summarizes the results of the valuation of energy savings, taking into account home heating offsets. These two exhibits present the net present value of energy savings attributable to the Program under the "past" and "future" cases.

PROGRAM COSTS

The net present value of program costs in 1983 dollars and at a 10% discount rate is as follows:

- For the past program, the NPV is $3.0 million (in 1978).
- For the future program, the NPV is $1.6 million (in 1984).

EXHIBIT S-3

VALUATION OF NET ENERGY SAVINGS
NET OF OFFSETS
(million 1983 $)
(10% discount rate)

Appliance	Past Program NPV in 1978		Future Program NPV in 1984					
	Base Case Energy Savings		Low Case Energy Savings		Base Case Energy Savings		High Case Energy Savings	
	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
Refrigerators	102.5	111.6	24.4	26.5	46.8	50.9	75.3	81.9
Freezers	65.6	68.2	3.6	3.6	16.6	17.2	22.1	22.9
Dishwashers	175.2	52.8	9.4	2.9	56.7	17.1	64.7	19.5
Clotheswashers	404.4	153.8	4.1	1.6	19.4	7.5	38.3	14.9
Ranges	26.9	6.4	0.0	0.0	0.0	0.0	7.1	2.3
Dryers	13.7	4.3	0.0	0.0	3.7	1.2	8.8	2.8
Total	788.4	397.1	41.5	34.8	143.2	93.9	216.3	144.3

SOURCE: Section VI
Appendix J

EXHIBIT S-4

COMPONENTS OF COSTS AND BENEFITS
PAST CASE
(million 1983$ - NPV in 1978)

	Base Case Energy Savings		
	5% Rate	10% Rate	15% Rate
ENERGY BENEFITS			
Value of Net Energy Benefits	723-1134	397-788	235-576
RESOURCE COSTS			
Program Costs			
Sourcing of Finished Products	3	3	3
Sourcing of Components	15	15	15
Retailer Costs	-	-	-
Consumer Search Costs	-	-	-
Passed-on Manufacturers' Costs	104-413	81-323	65-258
Product Performance	-	-	-
Foreign Trade Effects	-	-	-
Value of Resource Costs	122-437	99-341	83-276
Net Benefit (Cost)	286-1012	56-689	(23)-493
Benefit/Cost Ratio	1.65-9.30	1.16-7.96	0.85-6.94

OTHER COSTS TO BE CONSIDERED

There are a number of other types of costs to society which should be considered in the analysis. Quantitative estimates have been developed for two significant categories of cost, which are:

- The foreign exchange consequences of changes in the sourcing of components.
- Additional manufacturing costs, which are passed on to the consumers in the form of higher prices.

In the course of the study, it became clear that the Energuide program may also have resulted in some deterioration of product performance. We were unable to clearly identify and value such an effect.

COST-BENEFIT RESULTS

Exhibit S-4, opposite, and Exhibit S-5, overleaf, provide the basic results of the cost-benefit analysis for the "past" and "future" Programs. The results are presented with a range of social discount rates; it is intended that the 10% rate serve as the base case.

CONCLUSIONS AND GUIDELINES FOR INTERPRETATION

This study has developed a framework for assessing the benefit-cost relationship of the Energuide Program, both in the past, and with respect to possible Program extensions in the future. The methodologies employed do not permit satisfactory quantification of all of the important costs associated with the Program, and thus the results must be interpreted with considerable caution.

EXHIBIT S-6

COMPONENTS OF COSTS AND BENEFITS
FUTURE CASE
(million 1983$ - NPV in 1984)

	Base Case Energy Savings		
	5% Rate	10% Rate	15% Rate
ENERGY BENEFITS			
Value of Net Energy Benefits	149-173	94-143	63-122
RESOURCE COSTS			
Program Costs	2	2	2
Sourcing of Finished Products	-	-	-
Sourcing of Components	5	5	5
Retailer Costs	-	-	-
Consumer Search Costs	-	-	-
Passed-on Manufacturers' Costs	38-116	33-101	29-89
Product Performance	-	-	-
Foreign Trade Effects	-	-	-
Value of Resource Costs	45-123	40-108	36-96
Net Benefit (Cost)	26-128	(14)-103	(33)-86
Benefit/Cost Ratio	1.21-3.84	0.87-3.58	0.86-3.39

In this context, the study findings are as follows:

- The Energuide Program appears to have had a significant impact on gross energy savings in the past, and could be expected to have significant impact in the future.

- The quantitative estimates of benefits and costs are highly sensitive to changes in assumptions with respects to energy utilization and energy valuation.

- Depending on the range of assumptions chosen, net Program benefits vary considerably:

  - for the past, net benefits vary from $56 million to $689 million, and benefit-cost ratios from 1.2 to 8.0

  - for the future, net benefits range from minus $14 million to plus $103 million, and benefit-cost ratios from 0.9 to 3.6.

  - net benefits are higher at discount rates of 5% and lower at 15%.

I - INTRODUCTION

STUDY BACKGROUND

This document reports on a benefit-cost study of the Energuide program. The conduct of the benefit-cost study follows upon an earlier feasibility study conducted by Peat, Marwick and Partners.* That feasibility study provides initial information on the background of the study, and on the program.

TERMS OF REFERENCE

The terms of reference for the study are reproduced in their entirety as Annex 1 to this report. The most important aspects of the terms of reference are as follows.

Purpose and Objectives

This study is expected to determine the benefit-cost characteristics of the Energuide program.

The two major objectives of the engagement are:

- to measure the energy saving attributable to Energuide;
- to estimate costs and benefits incurred as a result of the Energuide Program.

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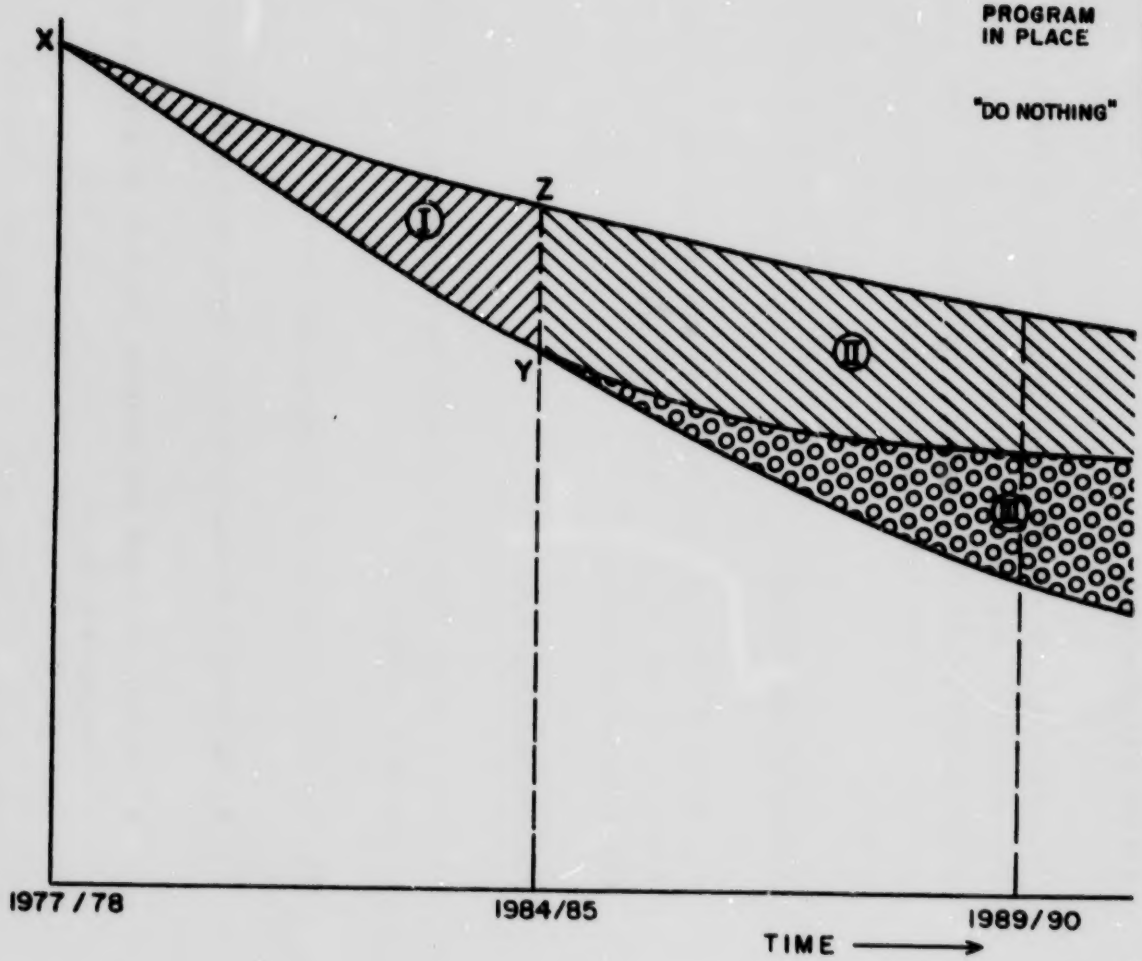
* Peat, Marwick and Partners, Feasibility of Conducting a Benefit-Cost Study of the Energuide Program, (draft report), February, 1984.

EXHIBIT I

ILLUSTRATION OF SCENARIOS FOR ANALYSIS

	PAST	FUTURE
PROGRAM IN PLACE	XYB	YC
"DO NOTHING"	XZA	YB



A ENERGY UTILIZATION WITHOUT PROGRAM (Scenario III)

B ENERGY UTILIZATION WITH PROGRAM IN PLACE TO 1985/86 THEN TERMINATED (Scenario II)

C ENERGY UTILIZATION WITH PROGRAM IN PLACE INDEFINITELY (Scenario I)

Timeframes

Costs and benefits are to be evaluated according to two timeframes. These are described in some detail in the feasibility study. Timeframes are:

- The "past", which incorporates program activities from 1976/77 to 1985/86, and their past and future impacts.

- The "future", which incorporates additional impacts flowing from a program extension from 1985/86 to 1989/90.

Exhibit 1, opposite, illustrates these basic scenarios. This exhibit is derived from the feasibility study, with minor modifications. The most important of these is the decision to place the effective division between "past" and in "future" in 1984/85. This reflects the view that program termination at March 31, 1986 would result in little program support in that final year.

Implications of the Terms of Reference

The timeframe within which the study was completed was very short. The Terms of Reference reflect this short timeframe, particularly in the choice of the lines of inquiry, identified in the feasibility study, which are actually pursued. There are several implications of this, which should be taken into account in considering the results presented in this study:

- The determination of energy savings requires the construction of hypothetical scenarios, based on the application of judgement to a wide range of information obtained in interviews and from secondary sources. One scenario has been constructed for the "past", and three for the "future". These scenarios can be assessed for reasonableness, but are, in the end, based only on informed judgement.

- The valuation of energy savings has been based on both a long term marginal social cost perspective and a consumer rate-based perspective.

- It is not possible to address satisfactorily some of the key elements of the total cost/benefit equation. The most important of these elements is the actual cost to the consumer and to society of incorporating energy saving features into labelled appliances.

In summary, the study has developed a logical framework for assessing the costs and benefits of the Energuide Program. Certain key elements of the framework have been addressed quantitatively only by using very broad assumptions. Based on research possible within the study timeframe, more realistic assumptions have been made with respect to other elements of the study. The sensitivity of results to certain key assumptions has been assessed. The results of the study should be interpreted in this context.

RESEARCH METHODOLOGY

The terms of reference identify a number of research questions which are to be explored. Specific lines of inquiry have been selected, in order to address these research questions. The research questions and lines of inquiry are also detailed in Annex 1. As is indicated in the feasibility study, the selection of these areas of inquiry determines the emphasis to be placed on individual research questions. Certain questions, while of interest, cannot be fully addressed with the lines of inquiry which were selected for this particular study.

STRUCTURE OF THIS REPORT

The main body of the report is structured according to the research questions addressed in this study. In particular:

- Sections II through V report on "Base Case" actual and hypothetical sales and energy efficiencies under the various scenarios, on an appliance-by-appliance basis. These are used to derive estimates of aggregate gross energy savings for the two cases of interest for each of the appliances.

- Section VI values these energy savings, taking into account space heating offsets.

- Section VII details program costs.

- Section VIII describes and quantifies other costs and benefits.

- Section IX summarizes the results, provides a number of key sensitivity analyses and estimates the benefits and costs of the program.

A series of appendices are structured in accordance with the lines of inquiry employed. Generally, there is one appendix for each line of inquiry outlined in the terms of reference. However, there has been some consolidation of lines of inquiry for reporting purposes.

EXHIBIT 2

REFRIGERATION PRODUCTS - REFRIGERATORS AND FREEZERS

Sales, Energy Consumption and Gross Energy Saved

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Sales - Historical and Projected ('000)													
Refrigerators		616	586	542	499	372	583	518	532	548	565	578	592
Freezers		318	335	341	322	272	279	288	295	300	305	310	310
Energy Consumption Scenarios (KWH/mo.)													
Refrigerators	I	138.4	138.2	134.7	121.5	116.9	115.1	111.1	107.3	103.6	100.0	96.6	93.3
	II	138.4	138.2	134.7	121.5	116.9	115.1	111.1	116.3	114.7	113.2	111.6	110.1
	III	138.4	141.7	140.6	140.2	140.4	144.0	142.9	141.9	136.9	132.1	127.4	123.0
Freezers	I	113.2	96.4	81.9	74.5	71.4	65.0	64.6	64.2	63.7	63.3	62.9	62.5
	II	113.2	96.4	81.9	74.5	71.4	65.0	64.6	71.3	71.5	71.8	72.0	72.2
	III	113.2	105.6	100.6	96.2	92.8	90.7	90.6	90.5	90.4	90.3	90.2	90.1
GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)													
Refrigerators	A	0.0	24.6	38.6	112.2	105.3	174.4	197.6	163.0	145.6	128.2	109.8	91.5
	B							—	57.4	72.8	89.2	104.6	119.3
Freezers	A	0.0	37.0	76.3	83.6	69.9	86.0	89.9	68.1	68.0	68.0	67.8	66.6
	B								25.2	28.1	31.0	33.9	36.4

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued
III = Past and Future without Energuide

Case A 1989 Savings Refrigerators = 592*(123.0-118.1)*12/1000

Cases

Case A = Energuide in place to 1984 then Discontinued (Scenario III - Scenario II)
Case B = Future Savings Generated by Continuing Energuide (Scenario II - Scenario I)

EXHIBIT 28

REFRIGERATION PRODUCTS

Detailed Scenarios

Refrigerators	Scenarios	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Manual Defrost	I	62.1	60.3	59.5	56.3	60.5	58.7	58.0	57.4	56.8	56.1	55.5	54.9
	II	62.1	60.3	59.5	56.3	60.5	58.7	58.0	58.0	58.0	58.0	58.0	58.0
	III	62.1	60.8	60.3	60.8	60.9	60.7	60.7	60.7	60.7	60.7	60.7	60.7
Other 1 Door	I	87.0	88.5	89.4	83.9	82.4	79.7	78.3	76.9	75.6	74.3	73.0	71.7
	II	87.0	88.5	89.4	83.9	82.4	79.7	78.3	78.3	78.3	78.3	78.3	78.3
	III	87.0	88.5	89.4	89.5	89.8	89.7	89.7	89.7	89.7	89.7	89.7	89.7
2 Dr FF TF	I	161.5	157.5	152.3	134.8	127.4	122.1	117.6	113.3	109.2	105.2	101.4	97.7
	II	161.5	157.5	152.3	134.8	127.4	122.1	117.6	123.5	121.7	119.8	118.0	116.3
	III	161.5	161.7	160.3	156.1	154.8	153.4	152.1	150.8	145.2	139.8	134.6	129.6
FF Side x Side	I	194.5	188.2	179.5	161.3	137.3	135.5	130.6	125.8	121.2	116.8	112.5	108.4
	II	194.5	188.2	179.5	161.3	137.3	135.5	130.6	137.1	135.0	133.0	131.0	129.0
	III	194.5	194.8	179.5	193.4	184.1	184.0	182.4	180.9	173.0	165.5	158.3	151.5
Total Refrigerators	I	138.4	138.2	134.7	121.5	116.9	115.1	111.1	107.3	103.6	100.0	96.6	93.3
	II	138.4	138.2	134.7	121.5	116.9	115.1	111.1	116.3	114.7	113.2	111.6	110.1
	III	138.4	141.7	140.6	140.2	140.4	144.0	142.9	141.9	136.9	132.1	127.4	123.0
Freezers													
Chest	I	110.1	92.7	77.6	70.4	68.2	62.1	61.5	60.9	60.3	59.7	59.1	58.5
	II	110.1	92.7	77.6	70.4	68.2	62.1	61.5	67.7	67.7	67.7	67.7	67.7
	III	110.1	102.1	96.7	92.2	88.7	87.1	86.8	86.4	86.1	85.7	85.4	85.0
Upright	I	149.3	137.5	125.6	116.4	99.6	94.4	93.5	92.5	91.6	90.7	89.8	88.9
	II	149.3	137.5	125.6	116.4	99.6	94.4	93.5	102.8	102.8	102.8	102.8	102.8
	III	149.3	144.6	139.9	136.2	129.4	127.4	126.9	126.4	125.9	125.4	124.9	124.4
Total Freezers	I	113.2	96.4	81.9	74.5	71.4	65.8	64.6	64.2	63.7	63.3	62.9	62.5
	II	113.2	96.4	81.9	74.5	71.4	65.8	64.6	71.3	71.5	71.8	72.0	72.2
	III	113.2	105.6	100.6	96.2	92.8	90.7	90.6	90.5	90.4	90.3	90.2	90.1

II - REFRIGERATION PRODUCTS - REFRIGERATORS AND FREEZERS

ACTUAL AND PROJECTED SALES

The actual and projected sales of refrigerators and freezers have been prepared by the Canadian Appliance Manufacturers Association (see Appendix C). This sales information is shown in Exhibit 2, opposite.

ACTUAL ENERGY USE

The actual energy use of a typical refrigerator and freezer to 1983 was developed in Appendix E. A summary of the actual energy consumption for these appliances in this period is shown as Scenarios I and II in Exhibit 2 and Exhibit 2A, opposite.

HYPOTHETICAL ENERGY USE

The hypothetical energy use for refrigerators and freezers was determined by postulating what the typical energy efficiencies of refrigerators and freezers could be and could have been under different scenarios or conditions. The views presented in this report are the result of an assessment of the evidence gathered during the study, and reported on in Appendices B, D, F and G. The results are described below, followed by the rationale for the Base Case selected. High and low cases are presented in Appendix J.

EXHIBIT 3

ENERGY CONSUMPTION SCENARIOS

(KWH/mo.)

REFRIGERATORS

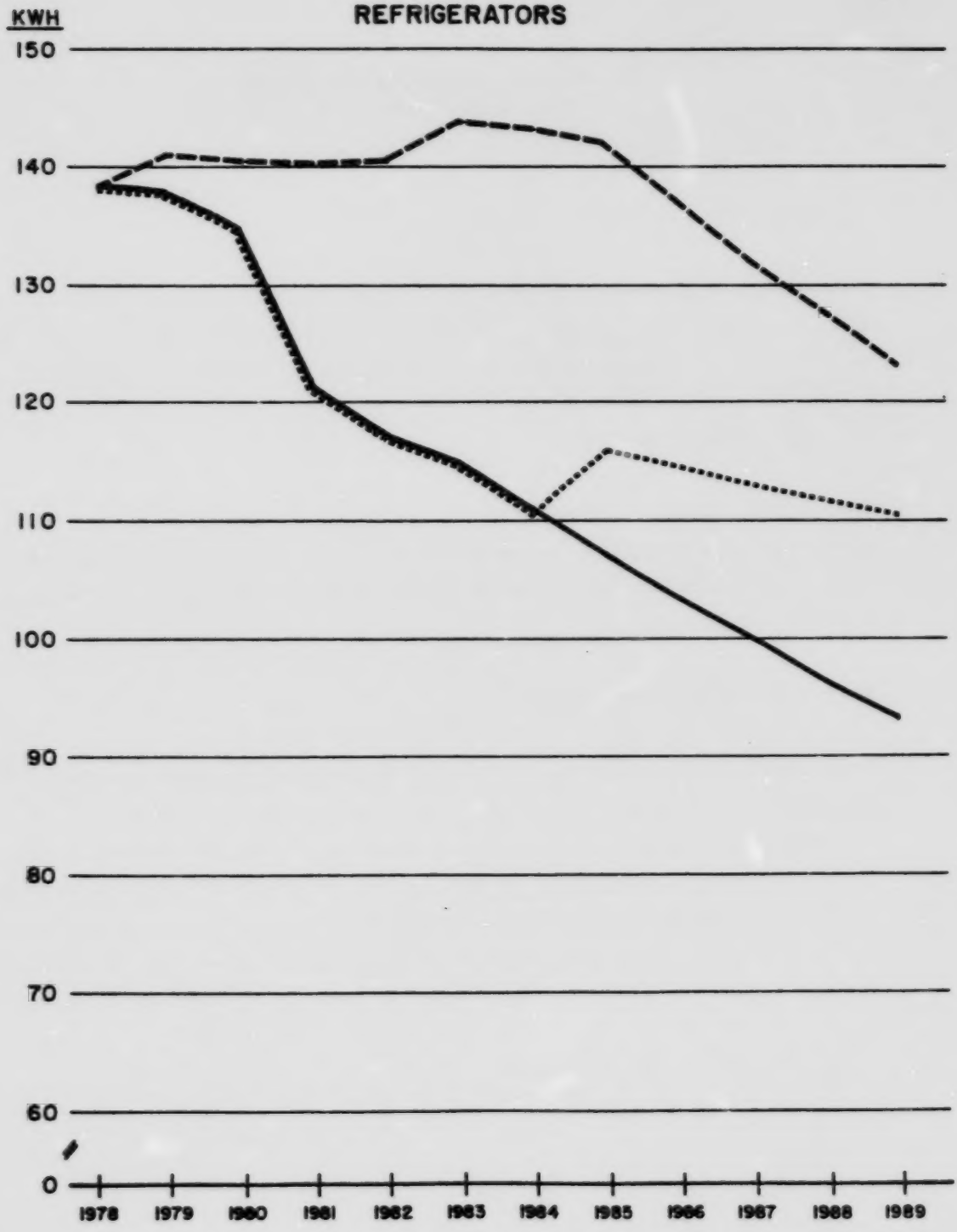
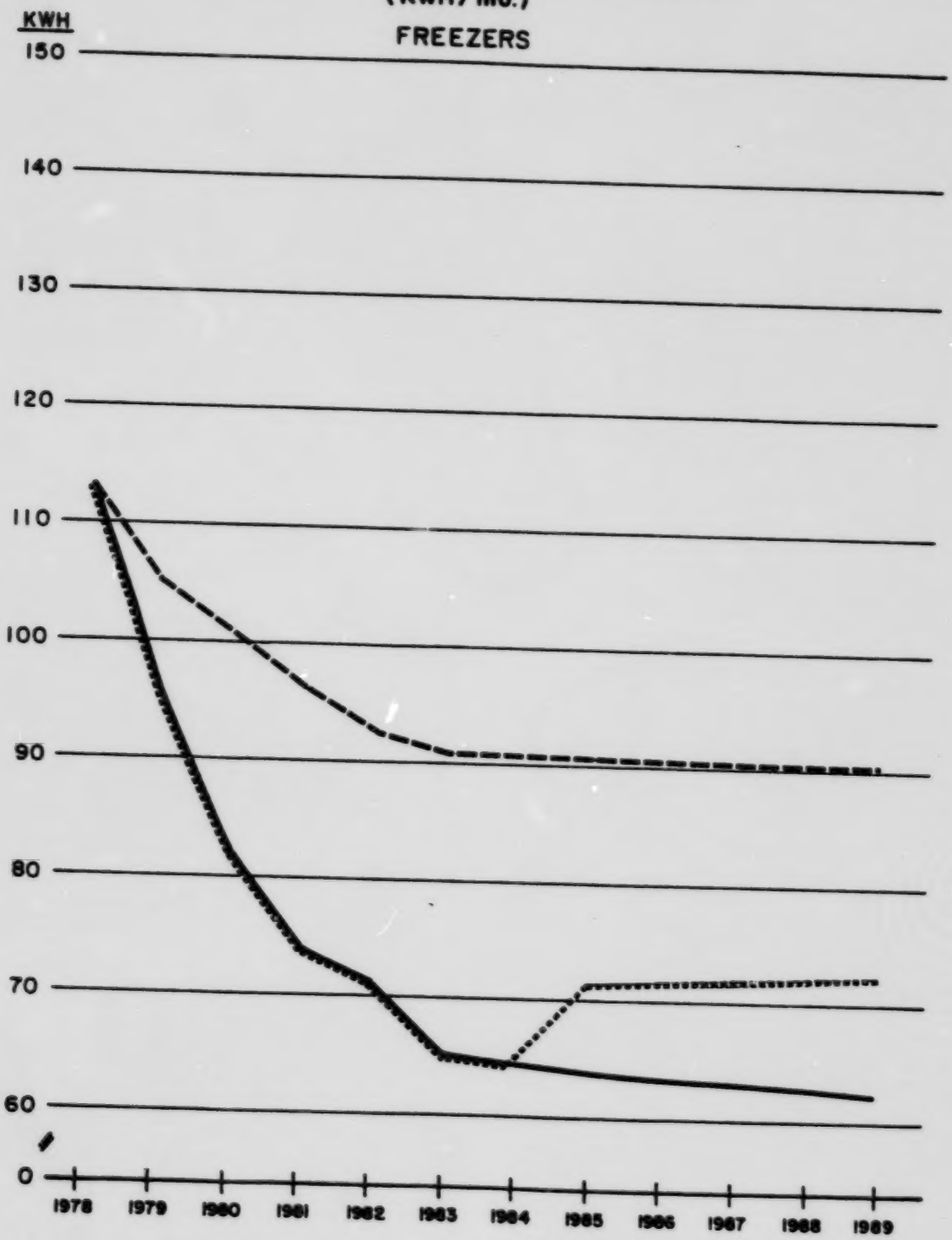


EXHIBIT 4

ENERGY CONSUMPTION SCENARIOS

(KWH/mo.)



GROSS ENERGY BENEFITS

Energy Consumption Scenarios

In Exhibit 2, the three energy consumption scenarios are shown. Scenario I provides estimates of energy consumption per unit with Energuide in place from 1978 to 1989. Scenario II gives typical energy consumption values from 1979 to 1984 with Energuide in place and provides estimates of per unit energy consumption values from 1985 to 1989 assuming Energuide were discontinued after 1984. Scenario III gives the hypothetical energy efficiencies of appliances had the Energuide Program never existed. The three scenarios are graphically illustrated for refrigerators and freezers in Exhibit 3 and 4, opposite, respectively. The scenarios chosen are intended to represent the base case or the median of the distribution of possible scenarios.

Energy Benefits

The gross energy benefits of the Program are expressed in gigawatt-hours saved/year by appliances purchased in a specific year. The annual gigawatt-hours saved is arrived at by multiplying the appliance sales (in thousands) by the unit kilowatt-hours saved per month by 12 months divided by 1,000. The benefits expressed in gigawatt-hours per year are developed for two cases:

- Case A - The benefits accruing from having the Energuide Program in place from 1978 to 1984 and that would continue to accrue to program if it were discontinued after 1984.

- Case B - The future benefits obtained by continuing the Energuide Program from 1985 to 1989.

These two cases for refrigerators and freezers are shown in Exhibit 2.

RATIONALE FOR BASE CASE

Past and Future Without Energuide (Scenario III)

Manual Defrost and Other One-Door Refrigerators

These products are considered by many in the industry as a utility product and sales of these refrigerators are not very energy sensitive. Furthermore, these refrigerators represent a small segment of the refrigerator market. In our assessment, no improvements to the energy efficiencies of these refrigerators would have been made before 1990.

Two-Door Frost-Free Top Freezers and Side-by-Side Refrigerators

The Canadian appliance industry is fragmented with more manufacturers than are required to supply the market. In the absence of an Energuide Program, the Canadian manufacturers, all with smaller than minimum efficient size plants, would have been reluctant to invest in new equipment to produce foam insulated units. The current equipment and setup costs have been estimated at between $1-4 million per plant. These costs may have placed any one manufacturer at a competitive cost disadvantage. In our assessment, foam insulation, which provides a significant level of savings, would not have been introduced before 1985.

High efficiency compressors would have been introduced into the refrigerator product lines. However, the shift to high efficiency compressors would have been at half the rate which has been achieved.

By 1984, the improvement in energy would have been 15% of what was achieved with Energuide in place. Because of the industry rationalization

which has taken place, significant investments in foam insulation equipment would have been made by appliance manufacturers. Consequently, the improvements in energy efficiency for refrigerators would have reached 50% of what would have been achieved by continuing the Energuide program to 1990.

A close examination of Scenario III for refrigerators would show that the predicted unit consumption values for 1979 to 1985 are higher than the 1978 unit consumption value. While the energy consumption levels for Two-Door Frost-Free Top Freezer and Side-by-Side Refrigerators are declining in Scenario III (see Exhibit 2A), the decline is not pronounced enough to offset the shift to larger and more energy consuming refrigerators.

Freezers

The move to polyurethane foam was inevitable. However, the move to 2 1/2 and 3 inch thick chests would not have occurred. The maximum chest wall thickness would have remained at 2 inches. Major reductions in the energy consumption of freezers would have come from the influence of the U.S. market. Two of three major Canadian freezer manufacturers export in significant volumes into the U.S. market and, as a consequence, the freezers sold by these manufacturers in Canada would have benefited the Canadian consumer regardless of the Energuide Program. In our assessment, the energy consumption of freezers would have declined by 40% from 1978 consumption levels, in the absence of the Energuide Program.

Future Without Energuide (Scenario II)

Manual Defrost and Other One-Door Refrigerators

Because of the energy insensitive nature of this segment, no further improvements are likely. In our assessment, the energy utilization of these types of refrigerators would not change.

Two-Door Frost-Free Top Freezer and Side-by-Side Refrigerators

In our assessment an initial drop of 5% in the energy efficiencies of these refrigerators would occur because of a move by manufacturers to substitute less expensive but more energy-consuming components. Thereafter, because of a momentum built up by the Energuide program and because of competitive pressures in the industry, the energy efficiency of these refrigerators would improve at a rate of 1.5% per year.

Freezers

Very high efficiency freezers are more costly. The lack of Energuide data would discourage consumers from purchasing these more expensive units. In our assessment, consumers would react negatively to the higher purchase price of high efficiency freezers. This would cause the weighted average energy consumption for freezers to increase initially by 10% and then to remain constant to 1990.

Future With Energuide (Scenaro I)

Manual Defrost and Other One-Door Refrigerators

The energy efficiency of these types of refrigerators has not increased dramatically since 1978. Because the market is relatively insensitive to the energy use of these refrigerators, future changes would occur at a rate equal to the compound rate achieved in the 1978 to 1983 period.

Two-Door Frost-Free and Side-by-Side Refrigerators

By 1989, the energy efficiency of these refrigerators would improve by about 20% to exceed the 1982 U.S. refrigerator efficiencies. The energy

efficiency improvements would come from compressor, insulation and refrigerant improvements. While the improvements are likely to occur in a stepwise fashion, the exact timing of these improvements is not known. Therefore, the improvement in the energy efficiency of these refrigerators is projected to occur at a constant compound rate.

Freezers

Freezers are now very efficient and future improvements are becoming increasingly difficult to achieve. In our assessment, the projected energy efficiency of freezers should improve at a rate of 1% per year from 1984 to 1989. The improvement would come primarily from more efficient compressors. The timing of the compressor change is unknown but should occur sometime within the period.

EXHIBIT 5

WASHING PRODUCTS - DISHWASHERS AND CLOTHESWASHERS

Sales, Energy Consumption and Gross Energy Saved

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Sales - Historical and Projected ('000)													
Dishwashers		291	333	388	274	215	246	262	274	291	303	320	332
Clotheswashers		558	537	534	484	484	465	481	496	508	520	529	539
Energy Consumption Scenarios (KWH/mo.)													
Dishwashers	I	143.1	143.1	143.1	119.7	108.1	104.1	103.7	103.4	103.0	102.7	102.3	102.0
	II	143.1	143.1	143.1	119.7	108.1	104.1	103.7	108.9	108.7	108.6	108.4	108.2
	III	143.1	143.1	143.1	131.4	121.6	123.6	123.4	123.2	123.1	122.9	122.7	122.5
Clotheswashers	I	137.3	137.3	137.3	103.0	101.5	99.3	97.8	96.3	94.9	93.5	92.1	90.7
	II	137.3	137.3	137.3	103.0	101.5	99.3	97.8	96.8	95.9	94.9	94.0	93.0
	III	137.3	137.3	137.3	132.7	128.3	124.0	119.9	118.7	117.5	116.3	115.2	114.0
GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)													
Dishwashers	A	0.0	0.0	0.0	38.5	55.5	57.6	61.9	47.1	50.0	52.1	55.1	57.2
	B								18.2	19.9	21.4	23.2	24.7
Clotheswashers	A	0.0	0.0	0.0	172.7	138.0	138.0	127.5	138.2	132.0	133.7	134.7	135.9
	B								2.9	5.9	8.9	12.0	15.0

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued
III = Past and Future without Energuide

Cases

Case A = Energuide in place to 1984 then Discontinued (Scenario III - Scenario II)
Case B = Future Savings Generated by Continuing Energuide (Scenario II - Scenario I)

III - WASHING PRODUCTS - DISHWASHERS AND CLOTHESWASHERS

ACTUAL AND PROJECTED SALES

The actual and projected future sales of dishwashers and clotheswashers have been prepared by CAMA (see Appendix C). The sales information for these appliances is shown in Exhibit 5, opposite.

ACTUAL ENERGY USE

The actual energy use of a typical dishwasher and clotheswasher to 1983 was developed in Appendix E. A summary of the actual energy consumption for these appliances in this period is shown as Scenarios I and II of Exhibit 5.

HYPOTHETICAL ENERGY USE

The hypothetical energy use of dishwashers and clotheswashers was determined by postulating what the typical energy efficiencies of dishwashers and clotheswashers could be and could have been under different scenarios or conditions. The views presented in this report are the result of an assessment of the evidence gathered during the study. (See Appendices B, D, F and G.) The results are reported on below, followed by the rationale for the Base Case selected. High and low cases are presented in Appendix J.

GROSS ENERGY BENEFITS

In Exhibit 5, the three energy consumption scenarios are shown. The three scenarios are graphically illustrated for dishwashers and clotheswashers in Exhibits 6 and 7, overleaf, respectively. The scenarios illus

EXHIBIT 6

ENERGY CONSUMPTION SCENARIOS

(KWH / mo.)

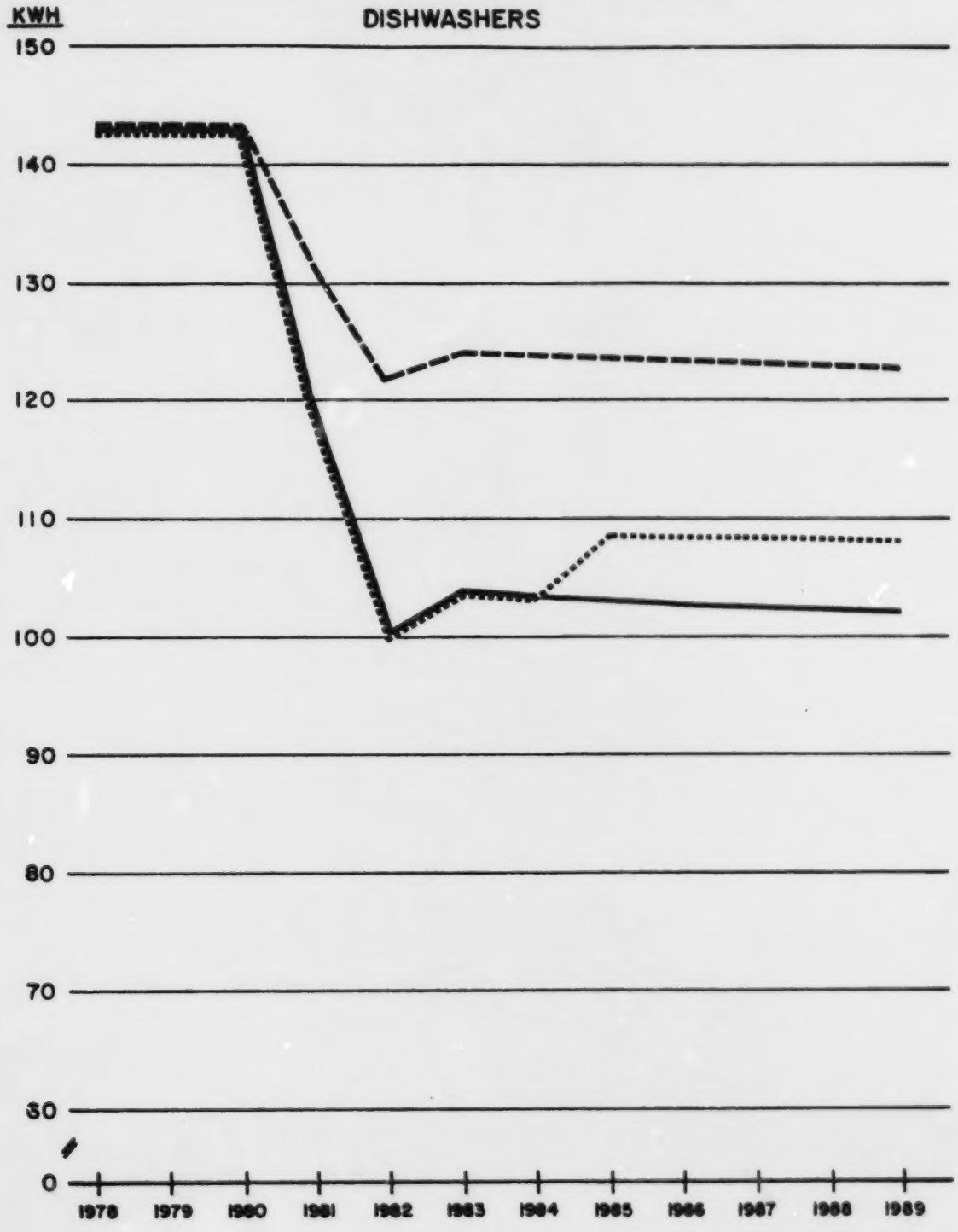
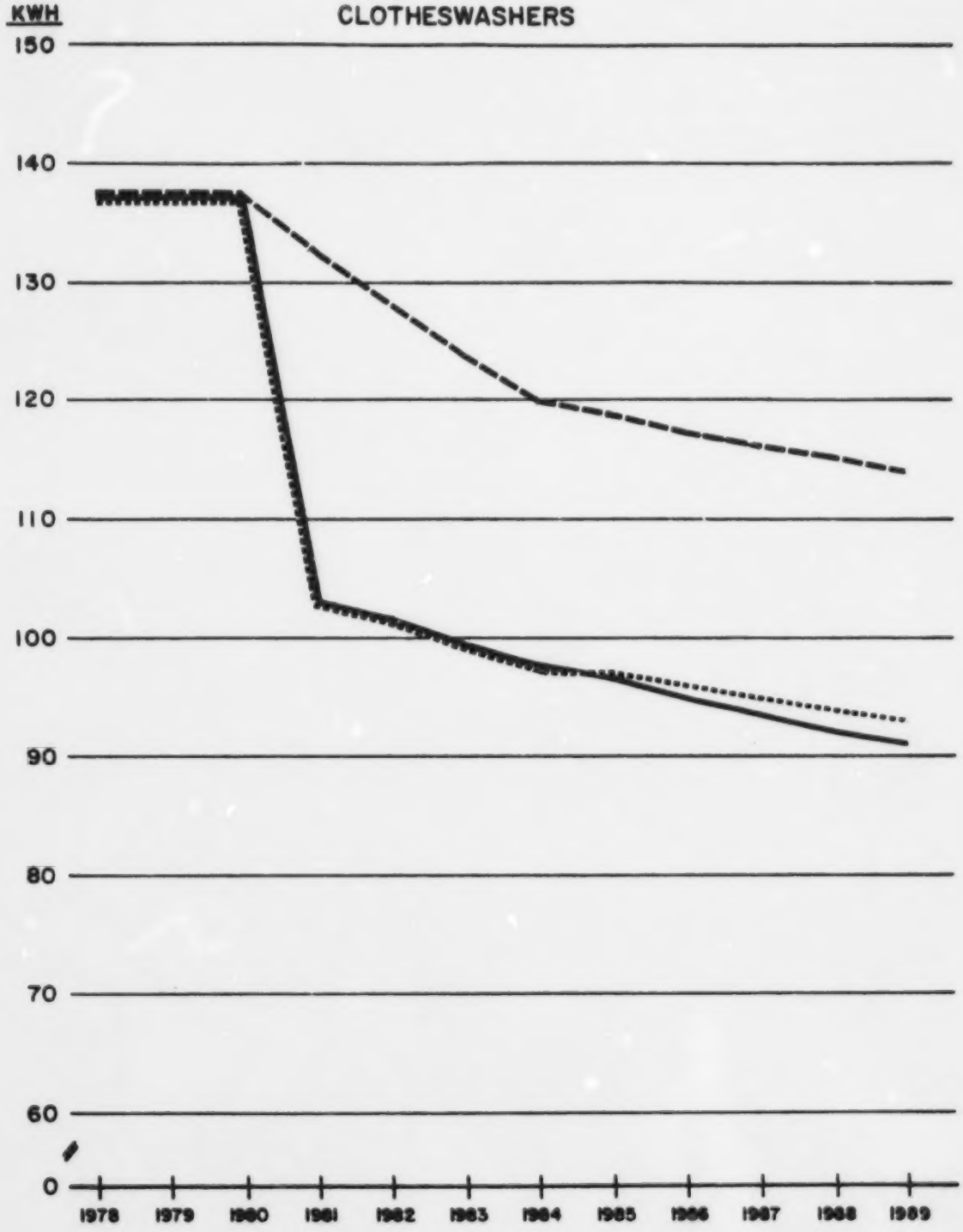


EXHIBIT 7

ENERGY CONSUMPTION SCENARIOS

(KWH / mo.)



trated are intended to represent the base case or median of the distribution of possible scenarios.

The gross energy benefits of the Energuide Program are expressed in gigawatt-hours saved /year by appliances purchased in a particular year. The benefits expressed in gigawatt-hours have been developed for the two cases shown in Exhibit 5.

RATIONALE FOR BASE CASE

Past and Future Without Energuide (Scenario III)

Dishwashers

U.S. appliance manufacturers enjoy a significant share of the Canadian dishwasher market. Because of declining energy consumption in dishwashers in the U.S. (see Appendix D), the significant U.S. share of the market would have lowered the Energuide rating in any event. Furthermore, because of the strong corporate links of Canadian dishwasher manufacturers with U.S. manufacturers, more energy-efficient appliances would have been introduced because of a transfer of technology from the U.S. to Canada. In our assessment, about 50% of the improvement that has taken place would have taken place because of manufacturer response to the consumer trend to lower hot water consumption. The energy consumption of dishwashers would continue to decline at about 50% of the anticipated decline with Energuide in place.

Clotheswashers

Because of a consumer shift to lower average wash temperatures, the Energuide ratings of clotheswashers would have declined. The use of the hot water rinse option would have declined even if manufacturers continued

to offer this option. In our assessment, 50% of the shift which occurred and is expected to occur between 1978 and 1985 would have occurred without Energuide. After 1985, the energy consumption of clotheswashers would continue to decline by 1% per year, reflecting consumer shifts to lower wash temperatures.

Future Without Energuide (Scenario II)

Dishwashers

Because of the current dissatisfaction of some dishwasher manufacturers with current product performance, hot water consumption would increase to improve dishwasher performance. Without an Energuide Program in place, the manufacturers will have little incentive to do more research and development to improve the energy performance of their dishwasher products. Therefore, the 1985 energy consumption of dishwashers is projected to be 5% above 1984 consumption levels. The anticipated energy efficiency improvement from 1985 to 1990 is 50% of the expected improvement with Energuide in place.

Clotheswashers

Because of a continuing societal shift to lower wash temperatures, the Energuide ratings of clotheswashers would continue to decline. However, because of a lack of energy consumption information, the energy consumption of clotheswashers would decline at a rate of 1% per year, instead of the 1.5% per year with the Energuide Program in place.

Future With Energuide (Scenario I)

Dishwashers

Very little future improvement in dishwasher energy efficiency is projected in the period 1984 to 1989. In our assessment, major energy reductions cannot be achieved without significant product performance deterioration. It is estimated that the 1990 consumption would be 2% lower than that achieved in 1983.

Clotheswashers

A continuing shift to cold water rinse and an increase in the compact washer share of the clotheswasher market, would lead to a decline of 1.5% per year from 1984 to achieve the 1981 U.S. levels by 1990.

EXHIBIT 8

ELECTRIC RANGES

Sales, Energy Consumption and Gross Energy Saved

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Sales - Historical and Projected ('000)													
Electric Ranges		506	470	430	402	315	404	414	426	440	455	468	481
Energy Consumption Scenarios (KWH/mo.)													
Electric Ranges	I	67.7	67.9	68.0	67.8	63.3	66.5	66.5	66.5	61.5	61.4	61.4	61.4
	II	67.7	67.9	68.0	67.8	63.3	66.5	66.5	66.5	61.5	61.4	61.4	61.4
	III	67.7	67.9	68.0	69.9	65.4	68.2	68.1	68.1	63.0	63.0	62.9	62.8
GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)													
Electric Ranges	A	0.0	0.0	0.0	10.1	0.0	0.1	7.9	0.2	7.9	0.7	0.4	0.1
	B								0.0	0.0	0.0	0.0	0.0

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued
III = Past and Future without Energuide

Cases

Case A = Energuide in place to 1984 then Discontinued (Scenario III - Scenario II)
Case B = Future Savings Generated by Continuing Energuide (Scenario II - Scenario I)

IV - ELECTRIC RANGES

ACTUAL AND PROJECTED SALES

The actual and projected future sales of electric ranges have been prepared by CAMA (see Appendix C). The sales information is shown in Exhibit 8, opposite.

ACTUAL ENERGY USE

The actual energy use of a typical electric range to 1983 was developed in Appendix E. A summary of the actual energy consumption for a typical range in this period is shown in Exhibit 8 (Scenarios I and II).

HYPOTHETICAL ENERGY USE

The hypothetical energy use for electric ranges was determined by postulating what the typical energy efficiencies of electric ranges could be and could have been under different scenarios or conditions. The views presented in this report are the result of an assessment of the evidence gathered during the study. (See Appendices B, D, F and G.) The results are described below, followed by the rationale for the Base Case selected. High and low cases are presented in Appendix J.

GROSS ENERGY BENEFITS

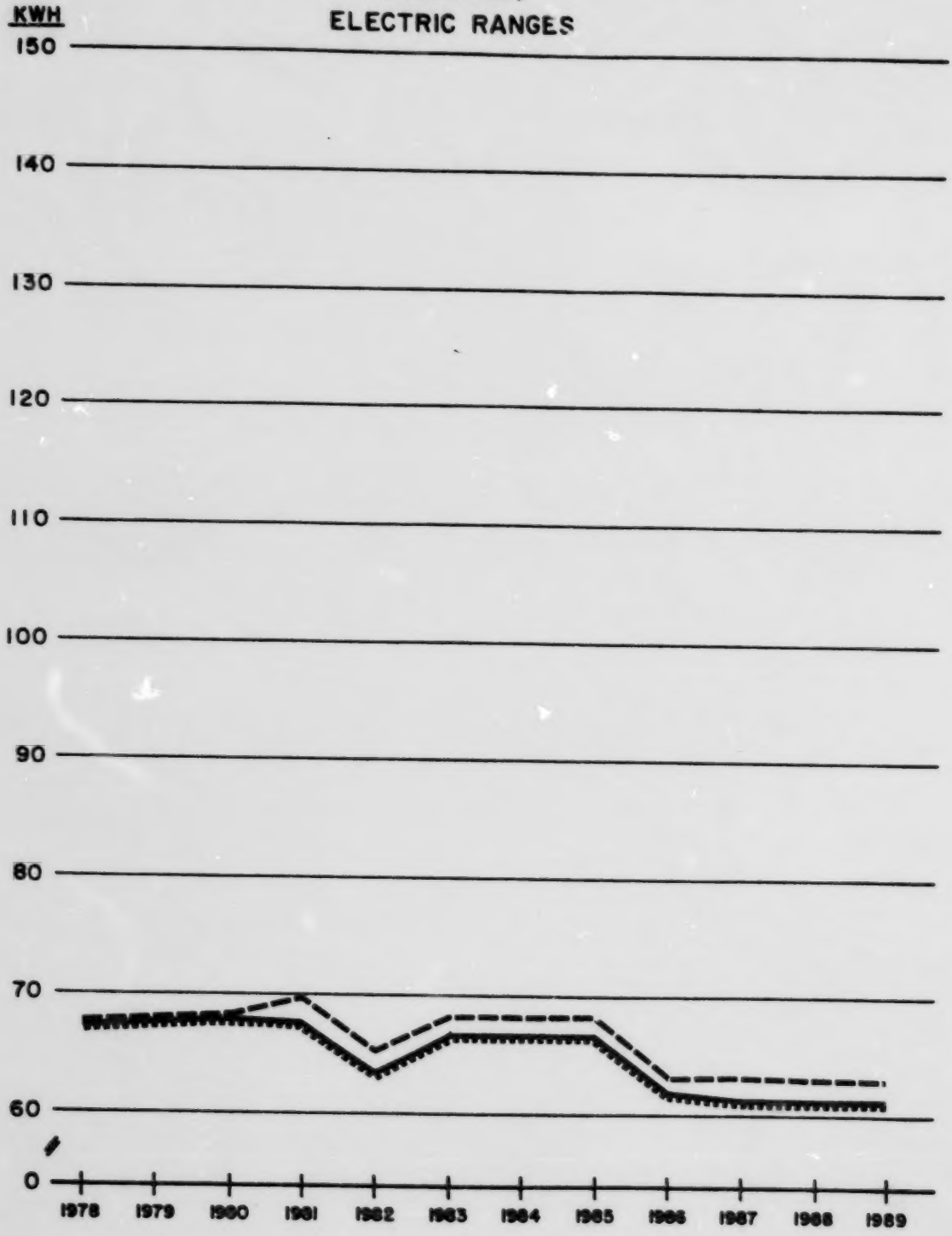
The three energy consumption scenarios are presented in Exhibit 8. The three scenarios are also graphically illustrated in Exhibit 9, overleaf. The scenarios illustrated are intended to represent the base case or median of the distribution of possible scenarios.

EXHIBIT 9

ENERGY CONSUMPTION SCENARIOS

(KWH/mo.)

ELECTRIC RANGES



The gross energy benefits of the Energuide Program are expressed in gigawatt-hours saved /year for the electric ranges purchased in a particular year. The two cases for which benefits are calculated are shown in Exhibit 8.

RATIONALE FOR BASE CASE

Past and Future Without Energuide (Scenario III)

In our assessment, the only improvements which would have been made to electric ranges is a 5 kwh/mo. saving occurring in 1986 because of strengthened CSA safety rules.

Future Without Energuide (Scenario II)

In our assessment, no future improvements would be made to ranges which would be attributable to the Energuide Program. It is assumed, however, than an improvement of 5 kwh/mo. will be made in 1986 because of a change in CSA safety standards.

Future With Energuide (Scenario I)

The improvement of 5 kwh/mo. described above is projected. This improvement will be made for safety reasons as required by CSA, and is not attributable to the Energuide Program. No new technological improvements are projected in the 1984-1989 period which would appreciably lower the energy consumption of electric ranges.

EXHIBIT 10

ELECTRIC DRYERS

Sales, Energy Consumption and Gross Energy Saved

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Sales - Historical and Projected ('000)													
Electric Dryers		389	388	375	341	277	325	341	353	363	375	385	395
Energy Consumption Scenarios (KWH/mo.)													
Electric Dryers	I	96.8	96.8	96.8	96.9	96.7	96.7	96.4	96.1	95.8	95.4	95.1	94.8
	II	96.8	96.8	96.8	96.9	96.7	96.7	96.4	96.2	96.0	95.7	95.5	95.3
	III	96.8	96.8	96.8	96.9	96.9	97.1	97.2	97.2	97.2	97.2	97.2	97.2
GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)													
Electric Dryers	A	0.0	0.0	0.0	0.0	0.5	1.6	3.3	4.3	5.3	6.8	7.9	9.1
	B								0.4	0.8	1.3	1.8	2.2

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued
III = Past and Future without Energuide

Cases

Case A = Energuide in place to 1984 then Discontinued (Scenario III - Scenario II)
Case B = Future Savings Generated by Continuing Energuide (Scenario II - Scenario I)

V - ELECTRIC DRYERS

ACTUAL AND PROJECTED SALES

The actual and projected future sales of electric dryers have been prepared by CAMA (see Appendix C). This sales information is shown in Exhibit 10, opposite.

ACTUAL ENERGY USE

The actual energy use of a typical dryer to 1983 was developed in Appendix E. The summary of the actual energy consumption for electric dryers in this period is shown as Scenarios I and II of Exhibit 10.

HYPOTHETICAL ENERGY USE

The hypothetical energy use of electric dryers was determined by postulating what the typical energy efficiencies of electric dryers could be and could have been under different scenarios or conditions. The views presented in the report are based on evidence gathered during the study. (See Appendices B, D, F and G.) The results are described below, followed by the rationale for the base case selected. High and low cases are presented in Appendix J.

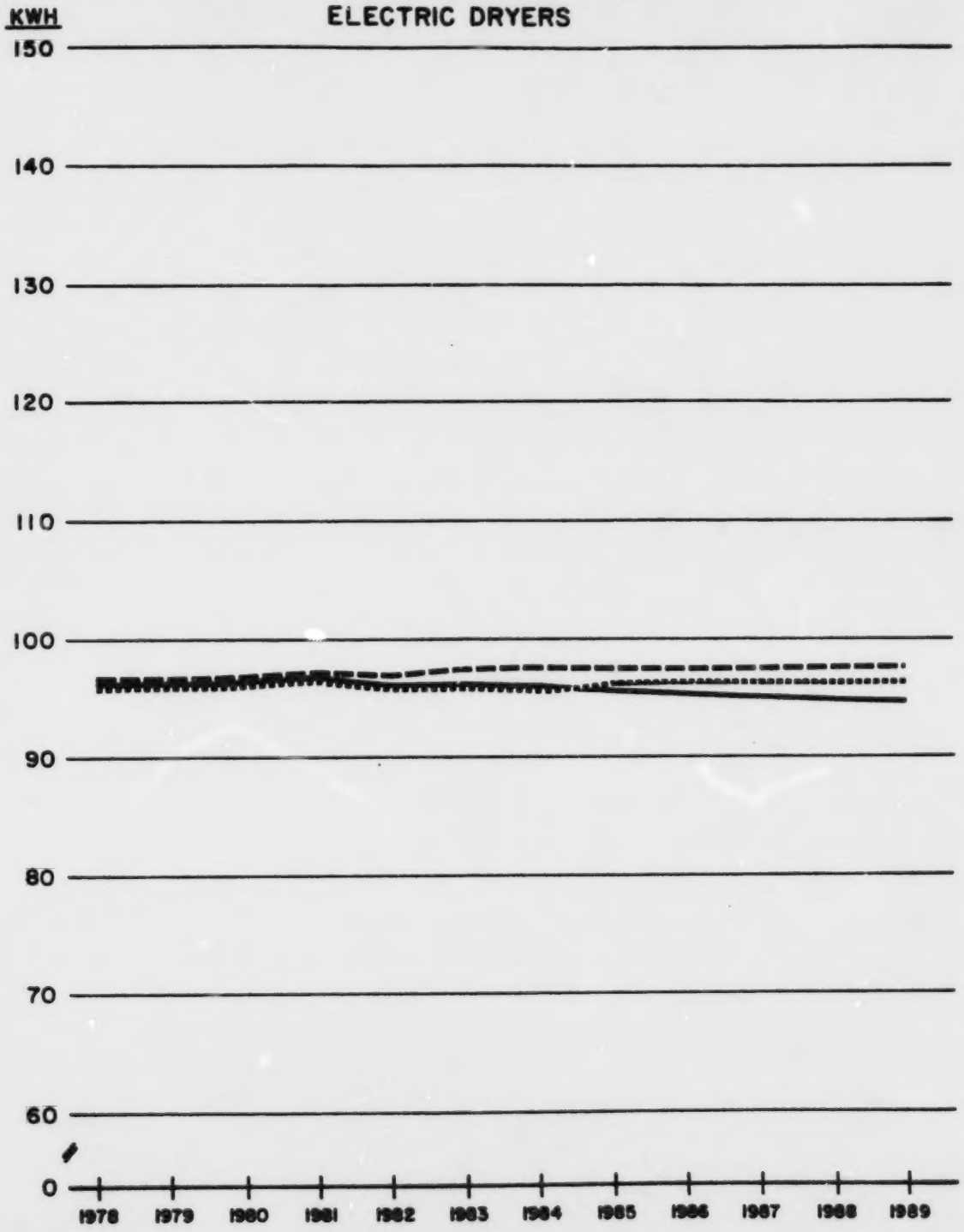
GROSS ENERGY BENEFITS

The three energy consumption scenarios are presented in Exhibit 10, and illustrated in Exhibit 11, overleaf. The scenarios illustrated are intended to represent the base case or median of the distribution of possible scenarios.

EXHIBIT II

ENERGY CONSUMPTION SCENARIOS

(KWH/mo.)



The gross energy benefits of the Energuide Program expressed in gigawatt-hours saved per year by electric dryers for the two cases considered are shown in Exhibit 10.

RATIONALE FOR BASE CASE

Past and Future Without Energuide (Scenario III)

In our assessment, no improvements would have been made to electric dryers prior to 1990. No new technological breakthroughs are projected which would substantially change the electric energy consumption of electric dryers.

Future Without Energuide (Scenario II)

In our assessment, manufacturers would not work on an improved dryer if the Energuide Program were not in place. Therefore, no improvements are projected to occur.

Future With Energuide (Scenario I)

In our assessment, marginal improvements can be made to improve the performance of the automatic options of electric dryers. The future energy consumption of electric dryers should continue to decline very slowly until 1990. No dramatic technological improvements are forecast in the 1984-1989 period.

VI - VALUATION OF ENERGY SAVINGS

VALUATION APPROACHES

Long Run Social Perspective

The value of energy savings was calculated considering the public perspective. This perspective takes into account the totality of savings accruing to all Canadians, not just those savings that accrue to the consumers who buy energy saving appliances. The savings accruing to all Canadians are higher than those accruing to the individual consumers for the reasons explained below.

1. The incremental costs of generating, transmitting and distributing electrical energy are higher than the average electricity rates that consumers pay, for the following two reasons:

   - The lowest cost energy sources have already been tapped in the past and, therefore, power utilities must turn to successively more costly sources.

   - Inflation has caused a substantial increase in the capital costs of new facilities while the "embedded investment" in existing facilities has remained at its original low level. Since electricity rates reflect the utilities' total booked investment, they reflect a blend of the low costs of old investments and the high costs of new investments. The incremental investment costs reflect only the latter.

The penetration of energy saving appliances allows a reduction in the construction of new generation, transmission and distribution facilities, and therefore, the value of the savings must be determined on the basis of incremental investment costs.

2. The value of natural gas and oil used in the heating of water for dishwashers and clothes washers (in those homes which do not have electric water heaters) is higher to society at large than to the individual consumer, due to the cross-subsidies inherent in the National Energy Policy. We assumed that the difference between the domestic price of natural gas and its export price approved by the National Energy Board represents the "social" premium that must be taken into consideration in any analysis carried out from the social perspective. With respect to oil, it was assumed that the difference between the world price and the domestic price of crude oil represents the social premium; this can also be construed as the price that Canada has to pay for the most costly part of its oil supply (i.e., imports of foreign oil), which is the part that is being reduced by the energy saving programs.

The future costs and benefits derived from the Energuide program are calculated in this study using social discount rates. The cost savings that are most consistent with this approach are those calculated from the social perspective as described above. For reasons outlined below, this approach represents an upper bound of the estimated value of energy savings.

Current Rates

The assumption that the social costs of energy are higher than present prices is related to assumptions of growth in demand on the one hand and the need to provide new capacity for satisfying that demand on the other. If undue overcapacity existed over the entire time horizon of this study,

social costs would approach the prices paid by the consumers for energy. In consideration of this alternative, we carried out a second set of calculations to estimate the lower bound of the estimated value of energy savings. In these calculations, we used the prices that consumers pay for energy.

To use the cost of new construction as the basis for calculating the marginal costs of electric power or energy can be regarded as the long-term approach. In a system with substantial unused capacity, the price at which electricity is being sold to the lowest-rate consumer can be regarded as the short-term marginal cost. The latter situation is prevalent in most provinces in Canada today. However, it is likely that the proportion of unnecessary excess capacity will diminish in the future and, therefore, marginal costs will tend to move toward their long run level.

The question arises: who are the "lowest rate" consumers? It may appear logical that electrical energy sold on a "spot" basis to U.S. utilities is in this category, since with excess capacity, it may be possible to reduce the rate to the pure marginal operating cost on a "when available" basis. Statistics show, however, that with the exception of Manitoba, all provinces export "spot" electricity at higher prices than the consumer rates. The reason is the higher cost of electricity in the United States and the existence of "market prices" which determine the export rate, regardless of the much lower marginal operating costs incurred by the Canadian utilities to produce the electricity sold.

Thus, consumer rates can be regarded as the lower limit for the valuation of savings achieved by the Energuide program.

CALCULATION OF INCREMENTAL COSTS

Two types of energy consumption were considered:

- The direct consumption of energy by the appliances. This energy consists partly of electricity, and partly of gas or oil for those appliances that consume hot water.

- An offset component of energy that reduces the direct energy savings achieved by the more energy-efficient appliances. This "offset" is the amount of space heating energy that is required for replacing the heat formerly generated by the less efficient appliance. This "offset" energy may be supplied by additional amounts of electricity, natural gas or oil used in the heating of homes, which ever type of energy is used for heating a particular type of dwelling.

The calculations of the amounts and costs of each energy component and their results are described below.

The Incremental Costs of Electricity

The incremental costs of generating, transmitting and distributing electrical energy were calculated by using the following assumptions:

1. For each province, the increase in the capital value of generating plant in service was determined between 1979 and 1981 (the last year for which financial statements, published by Statistics Canada, are available). This increase was divided by the increase in generating capacity put into service during the period. This provided an estimate of the incremental capital costs per kilowatt capacity installed. The amount was escalated to 1983 dollars by applying a factor of 1.25 to the average of the 1980 and 1981 costs.

In this "upper bound" case, the issue of excess capacity was ignored. It was realized that in some provinces a certain percentage of spare or "protection" capacity would have to be added to the new operating capacity required by the increase in demand. On the other hand, other provinces have an over-capacity that will allow a reduction in new capacity required in the next few years. At the present time, the latter type of impact is more pronounced than the former at the national level.

2. The approach described above was judgementally modified for those provinces in which the development of future generation was expected to be different from that experienced in 1980 and 1981, or where a disproportionately small amount of capacity was added to the system during that period. The modifications were based by adding earlier years to the estimating base for incremental capacity or by considering the data of other provinces.

The following forms of <u>incremental</u> generation were assumed for each province:

- Newfoundland: Oil
- Nova Scotia: Coal
- New Brunswick: Nuclear
- P.E.I: Supplied from News Brunswick
- Quebec: Hydro
- Ontario: Nuclear
- Manitoba: Hydro
- Saskatchewan: Coal
- Alberta: Coal
- British Columbia: Hydro.

EXHIBIT 12

INCREMENTAL CAPITAL AND OPERATING COSTS OF ELECTRIC UTILITIES (1983 $)

	Incremental Cost of New Plant	Operating Costs (incl. fuel)	Incremental Form of Generation	1983 Consumer Rate[1]
	$/watt	¢/kwhr		
Atlantic	1.40	3.2	1/3 oil 1/3 coal 1/3 nuclear	4.5
Quebec	2.20	1.2	Hydro	3.2
Ontario	1.90	1.6	Nuclear	3.7
Manitoba	2.20	1.45	Hydro	2.5
Saskatchewan	1.90	2.5	Coal	3.4
Alberta	1.40	2.05	Coal	3.85
B.C.	1.70	1.35	Hydro	3.75

SOURCE: Statistics Canada, #57-202,
Peat Marwick Research

1 Residential rates for amounts over 500 kw hrs/month.

3. The incremental cost of transmission and distribution was calculated by dividing the incremental investment shown in the financial statements by an assumed systems growth. The rate of growth was assumed to be equal to that of the peak demand in the province during the past ten years. The incremental costs per kilowatt of transmission/distribution capacity calculated in this manner were added to the costs per kilowatt calculated for the incremental generating capacity.

4. The utilities' incremental operating costs were assumed to be equal to their average costs, including labour, materials and fuel. This assumption implies that the costs of fuels do not increase at a faster rate than wages and other operating costs and that the mix of hydro/nuclear generation on the one hand and coal/gas/oil generation on the other remains unchanged.[1] To obtain the 1983 estimates the 1981 operating cost data were escalated by 25 percent. Operating costs were expressed in cents per kilowatt-hour.

Exhibit 12, opposite, shows the incremental capital and operating costs calculated for each province. The exhibit also provides appropriate residential rates for 1983, which are the basis of the lower bound valuation.

Natural Gas Costs

The incremental costs of natural gas were calculated in a somewhat simpler manner but still maintaining the general philosophy of separating capital

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1 This is broadly true in most systems if the Atlantic region is considered as one. Note that even though the sources of generation may be mixed generally only one form of new generation is being built, as the other forms in the mix have enough excess capacity.

EXHIBIT 13

COST ASSUMPTIONS
FOR NATURAL GAS SUPPLY
(1983 $)

	Incremental Cost of New Plant in $/watt[1]	Operating Costs (incl. cost of gas) in ¢/m³ (3)			
		Consumer Rate	Less Capital Portion	Plus Export Premium[2]	Total
Atlantic	-	-	-	-	-
Quebec	0.5	21.6	2.8	5.0	23.8
Ontario	0.4	18.6	2.2	5.0	21.4
Manitoba	0.2	16.5	1.1	5.0	20.4
Saskatchewan	0.1	11.3	0.6	5.0	15.7
Alberta	-	10.5	-	5.0	15.5
B.C.	0.1	13.8	0.6	5.0	18.2

(1) Electrical heating equivalent
(2) Opportunity cost
(3) Electrical equivalent per kwhr is obtained by dividing these costs by 6.5

costs from operating costs. Since the impacts of natural gas costs on the results of this study are relatively small in comparison with the impacts of electricity costs, only very broad assumptions were made regarding the incremental capital costs of supplying natural gas.

Exhibit 13, opposite, shows the cost assumptions made in terms of equivalent kilowatt-hours of electricity replaced by natural gas. Considering average furnace efficiencies it was assumed that 6.5 kilowatt-hours are equivalent to one cubic meter of natural gas consumed.

Following the analogy of capital and operating costs applied to electricity, we assumed that the "operating costs" of natural gas were equal to the consumer rate of gas less an amount that covers the cost of capital embedded in the pipelines. The amounts used in the calculations are shown in Exhibit 13: they have to be divided by 6.5 to obtain the equivalent amounts for a kilowatt-hour of electricity.

The social cost premium on natural gas was estimated broadly to be 5 cents per cubic meter. In gross terms, this is the differential between the incentive export price identified in July 1983 by the Federal Government and the domestic gas price. The impact of this amount is also shown in Exhibit 13.

Oil Prices

In the case of oil there is no capital component. A uniform price of 32¢ per litre was assumed across Canada, representing average as well as incremental costs. A surcharge of 5 cents per litre was added to represent the social perspective, assuming that this is the average amount by which the price of import crude oil exceeds the "blended" domestic price[1]. Consider-

1. Note that oil prices are averaged across Canada, regardless of the actual use of domestic vs. imported oil in a particular province.

EXHIBIT 14

PERCENTAGE OF WATER HEATERS BY TYPE OF FUEL

	Electric (%)	Gas (%)	Oil and Other (%)
Atlantic	55	-	45
Quebec	79	7	14
Ontario	48	50	2
Manitoba	48	52	-
Saskatchewan	29	71	-
Alberta	4	96	-
B.C.	42	51	7

Source: Statistics Canada #64-202, May 1983

ing furnace efficiencies it was assumed that one litre of oil consumed is equivalent to 7 kilowatt-hours of electricity.

ENERGY CONSUMPTION OF APPLIANCES AND THEIR LOAD IMPOSED ON THE SYSTEM - THE "UPPER BOUND" SCENARIO

The energy consumption of the various appliances under various scenarios has been addressed in detail in Sections II-V. At this stage we made only one adjustment: for the energy required by dishwashers and clothes-washers we estimated the proportion of equivalent kilowatt-hours that are generated by gas or oil in those homes that have non-electric water heaters. The proportion of such homes is shown in Exhibit 14, opposite, for each province.

It was assumed, however, that in all cases dishwashers consume about 80 percent of their energy requirements in the form of hot water and that clothes washers consume 95 percent (based on an Ontario Hydro Report entitled "The Potential for Energy Conservation in Major Electrical Appliances", prepared for the CEA in April 1982).

The report referenced above was also used to estimate the load that appliances impose on the system. According to Table I, page 1, of the quoted report, a refrigerator or freezer will impose, on average, 1.35 watts of load on the system during the system peak for each kilowatt-hour consumed per month. The following values were assumed for each appliance:

Refrigerators:	1.35	watts per kilowatt-hour consumed each month
Freezers:	1.35	"
Dishwashers:	6.50	"
Clothes washers:	4.80	"
Ranges:	6.15	"
Dryers:	4.70	"

It was assumed that the load represented by water heaters is coincident with the operation of the appliances, i.e., the water heater load is not managed on a time-of-the-day basis. This is consistent with current practices in most municipalities within Canada.

The total incremental costs of energy consumed by an appliance were assumed to be equal to the total of:

- a one-time capital cost resulting from the additional load that the appliance imposes on the system, and

- a stream of annual operating costs represented by the kilowatt-hour consumption of the appliance.

As noted, the capital and operating costs relate entirely to the electrical system in the case of refrigerators, freezers, ranges and dryers. The same is true for dishwashers and clothes washers in homes with electric water heaters. In homes with gas or oil water heaters significant portions of the costs generated by the latter two appliances relate to the gas or oil supply system.

The relationships between the costs of an appliance borne by the consumer and the system costs caused by the appliance are not always fully appreciated. As shown below, the incremental system capital costs generated by one additional appliance can be very high. For example, a typical range, which consumes 55 kilowatt-hours per month, imposes a load of 400 watts on the system (400/65 = 6.15: see factor above). The incremental capital costs to provide facilities for the generation, transmission and distribution of 400 watts in Ontario is 1.9 x 400 = $760 (see Exhibit 12). Thus, when a new family adds one new range to the system, the utility, in order to supply the range with power, must put up a capital cost of the same magnitude as the amount that the family pays for the range.

Offsets

All appliances transform some or all of their primary energy consumed into heat of some form. In the case of dishwashers and clothes washers, most of this heat is drained from the home in the form of warm water. In the case of dryers, most of the heat is vented out of the home.[1] In the case of refrigerators, freezers and ranges all of the heat gained through transformation from the primary energy sources remains in the home and, during the winter months, replaces some of the required space heating energy.

The following percentages of the total energy consumed by appliances were assumed to be dissipated in the home in the form of space heat:

Refrigerators:	100%
Freezers:	100%
Dishwashers:	20%
Clothes washers:	5%
Ranges:	100%
Dryers:	15%.

When electrical energy is saved by one of these appliances, the equivalent amount of extra space heating energy must be supplied during the winter to keep the house at the desired temperature level. The cost of that substitute energy must be subtracted from the savings. This cost is termed an "offset".

The fact that an appliance may be located in a different part of the house than in the area where most of the space heating is required has been ignored in this study. This approach over-estimates the impact of "offsets"

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1. If vented into the home, the humid air will eventually also be vented out through increased ventilation.

EXHIBIT 15

PERCENTAGE OF FORM OF SPACE HEATING

	Electric (%)	Gas (%)	Oil and Other (%)
Atlantic	20	-	80
Quebec	48	8	44
Ontario	16	56	28
Manitoba	25	60	15
Saskatchewan	4	76	20
Alberta	-	95	5
B.C.	18	56	26

Source: Statistics Canada #64-202, May 1983

since, for example, when the heat of a freezer is generated in the basement it will unnecessarily heat up a rarely used area and a reduction in the heat generated by the freezer would never be made up from conventional space heating sources. For these reasons, we have presented the results of the analysis both with and without the impacts of offsets, with the understanding that the true benefits lie somewhere between the two results.

Offsets were calculated in consideration of the types of space heating that is being used in the various provinces, as shown in Exhibit 15, opposite. The costs of the substitute space heat were subtracted from the cost savings achieved by the appliances.

There are, of course, no space-heating offsets during the summer months. The number of months during which space heating is not required and, therefore, the full amounts of the savings produced by an appliance would be valid, was assumed to be seven months in British Columbia, five months in the Prairie Provinces, and six months in Central and Eastern Canada.

Conceptually, there is also a credit for reduced energy use in air-conditioning in summer summer months. This is probably insignificant, and has been ignored on this analysis.

THE "LOWER BOUND" SCENARIO

The analysis of the "low energy cost" scenario was carried out along the same principles as the analysis for the "high energy cost" scenario, except that the cost of all forms of energy were assumed to be equal to the rates paid by the consumers in 1983. These are shown for electricity in Exhibit 12 and for natural gas in Exhibit 13. As noted earlier, a uniform price of 32¢ per litre was assumed as the price of oil across Canada.

Regarding the future, it was assumed that the consumer prices of energy will increase at the same rate as general inflation.

EXHIBIT 16-D

CANADA TOTALS

Savings in 1983 constant dollars (millions)

Case B_1 With offsets

	NPV 1984	1985	1986	1987	1988	1989
Refrigerators	46.8	8.3	10.5	12.8	15.0	17.2
Freezers	16.6	3.6	4.0	4.5	4.9	5.2
Dishwashers	56.7	12.9	14.1	15.1	16.4	17.4
Clotheswashers	19.4	1.8	3.6	5.5	7.3	9.2
Ranges	0.0	0.0	0.0	0.0	0.0	0.0
Dryers	3.7	0.3	0.7	1.0	1.4	1.8
	143.2	26.9	32.9	38.9	45.0	50.9

EXHIBIT 16-C

CANADA TOTALS

Savings in 1983 constant dollars (millions)

Case A, With offsets

	NPV 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Refrigerators	102.5	3.5	5.5	16.2	15.4	25.0	28.5	23.5	21.0	18.5	15.8	13.2
Freezers	65.6	5.3	11.0	12.0	10.1	12.3	12.9	9.8	9.8	9.8	9.8	9.6
Dishwashers	175.2	0.0	0.0	26.6	38.8	41.5	43.7	33.2	35.3	36.8	38.9	40.4
Clotheswashers	404.4	0.0	0.0	104.1	79.8	85.8	78.1	79.7	80.8	81.9	82.5	83.2
Ranges	26.9	0.0	0.0	6.0	5.4	5.4	5.3	5.5	5.3	5.0	5.6	5.4
Dryers	13.7	0.0	0.0	0.0	0.4	1.3	2.6	3.4	4.3	5.5	6.4	7.4
	788.4	8.9	16.5	165.7	149.8	171.3	171.2	155.2	156.5	158.3	159.0	159.2

EXHIBIT 16-B

CANADA TOTALS

Savings in 1983 constant dollars (millions)

Case B, No offsets

	NPV 1984	1985	1986	1987	1988	1989
Refrigerators	108.9	19.3	24.5	29.8	34.9	40.0
Freezers	39.1	8.6	9.5	10.5	11.5	12.3
Dishwashers	90.8	20.6	22.6	24.2	26.2	28.0
Clotheswashers	27.8	2.6	5.2	7.8	10.5	13.2
Ranges	0.0	0.0	0.0	0.0	0.0	0.0
Dryers	4.0	0.4	0.7	1.1	1.5	1.9
	270.6	51.4	62.5	73.4	84.7	95.5

EXHIBIT 16-A

CANADA TOTALS

Savings in 1983 constant dollars (millions)

Case A_1 No offsets

	NPV 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Refrigerators	238.7	8.3	12.9	37.6	35.3	50.8	66.3	54.8	48.9	43.1	36.9	30.7
Freezers	154.7	12.5	25.8	28.3	23.8	29.2	30.5	23.1	23.1	23.0	23.0	22.6
Dishwashers	288.9	0.0	0.0	43.3	62.5	65.5	70.0	53.3	56.6	59.0	62.3	64.7
Clotheswashers	579.6	0.0	0.0	150.9	114.1	121.6	111.9	114.2	115.8	117.3	118.2	119.2
Ranges	43.5	0.0	0.0	10.9	8.6	8.8	8.6	8.9	8.6	9.5	9.1	8.7
Dryers	14.6	0.0	0.0	0.0	0.5	1.4	2.0	3.7	4.5	5.9	6.0	7.9
	1312.1	20.8	38.7	270.9	244.7	285.3	290.1	257.0	257.5	257.7	256.3	253.0

In the case of gas and oil, there is considerable uncertainty regarding future prices. The cancellation of most projects that have been based on a forecast of energy prices rising faster than general inflation indicates a change in the industry's view on the expectations of future energy prices. Accordingly, it is not unreasonable to assume that the real prices of oil and gas will remain unchanged for some time to come.

Electricity rates are certainly not expected to rise at a lower rate than general inflation. If they increased at a higher rate, our estimates of energy savings would move closer to the "high energy cost" scenario.

RESULTS

Upper Bound Results

The results of the analysis are shown in Exhibits 16A through 16D, opposite, for the "high energy cost" scenario, i.e., for the case in which the incremental capital costs of new plants are considered. A real social discount rate of 10% was assumed in calculating the present values of the savings. (Variations on discount rates are dealt with in Section IX.) The approach applied to the preparation of these tables was as follows:

- The capital cost savings in the energy supply system were assumed to be instantaneous, i.e., when an appliance is purchased that imposes a smaller load on the system than an earlier appliance type, the construction of the plant that would be necessary to supply that amount of load is immediately deferred.

- Each appliance was assumed to save the entire amount of money that it will actually save throughout its lifetime in one "lump" sum at the time of its purchase subject to the discounting procedures described below.

- It was assumed that all costs will rise with the general rate of inflation.

- The energy savings throughout the life of the appliance were discounted at a real social discount rate of 10% per annum to the time of purchase, assuming an economic life of 15 years. If the appliance were to be used for a longer period of time the benefits would increase. The annual figures shown in Exhibit 16 thus show, in a particular year, the long term impacts of the buying decisions made by the consumers in that year. An appliance purchased in 1989 would, therefore, show benefits reaching out to the year 2004.

The savings, defined in the manner described above, are shown in Exhibit 16 for Cases A and B.[1] They are shown annually as well as in the form of their Net Present Value at the end of 1978 (for Case A) and at the end of 1984 (for Case B). As noted, the Net Present Values were calculated using a 10 percent real social discount rate. All the data in Exhibit 16 are in 1983 constant dollars. Exhibits 16A and 16B show the results without space heating offsets, Exhibits 16C and 16D show the results with offsets.

The equations and the methods of calculation applied to the derivation of the figures in Exhibit 16 are summarized in Appendix I.

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1 Defined in Section II. "Case A" shows the savings that have resulted and will result from the fact that the ENERGUIDE program has been in effect until now. "Case B" shows the additional savings expected from the continuation of the program.

EXHIBIT 17-D

CANADA TOTALS

Savings in 1983 constant dollars (millions)

Case B, With offsets

	NPV 1984	1985	1986	1987	1988	1989
Refrigerators	58.9	9.8	11.5	13.9	16.3	18.7
Freezers	17.2	3.8	4.2	4.6	5.1	5.4
Dishwashers	17.1	3.9	4.2	4.5	4.9	5.3
Clotheswashers	7.5	0.7	1.4	2.1	2.8	3.5
Ranges	0.0	0.0	0.0	0.0	0.0	0.0
Dryers	1.2	0.1	0.2	0.3	0.4	0.6
	93.9	17.4	21.5	25.5	29.6	33.5

EXHIBIT 17-C

CANADA TOTALS

Savings in 1983 constant dollars (millions)

Case A, With offsets

	NPV 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Refrigerators	111.6	3.8	6.1	17.7	16.8	27.1	31.0	25.6	22.9	20.1	17.2	14.4
Freezers	68.2	5.6	11.5	12.4	10.4	12.8	13.4	10.2	10.2	10.2	10.1	10.0
Dishwashers	52.8	0.0	0.0	8.1	11.8	12.4	13.2	10.0	10.6	11.1	11.7	12.2
Clotheswashers	133.8	0.0	0.0	39.8	38.3	32.4	29.7	30.3	30.7	31.1	31.4	31.6
Ranges	6.4	0.0	0.0	1.6	1.3	1.3	1.3	1.3	1.2	1.4	1.3	1.3
Dryers	4.3	0.0	0.0	0.0	0.1	0.4	0.8	1.1	1.3	1.7	2.0	2.3
	397.1	9.4	17.6	79.6	78.7	86.3	89.4	78.5	77.0	75.6	73.8	71.7

EXHIBIT 17-B

CANADA TOTALS

Savings in 1983 constant dollars (millions)

Case B, No offsets

	NPV 1984	1985	1986	1987	1988	1989
Refrigerators	88.4	15.6	19.9	24.2	28.3	32.5
Freezers	31.2	6.8	7.6	8.4	9.2	9.9
Dishwashers	18.8	4.3	4.7	5.0	5.4	5.8
Clotheswashers	7.7	0.7	1.4	2.2	2.9	3.6
Ranges	0.0	0.0	0.0	0.0	0.0	0.0
Dryers	1.3	0.1	0.2	0.4	0.5	0.6
	147.4	27.6	33.8	40.1	46.4	52.4

EXHIBIT 17-A

CANADA TOTALS

Savings in 1983 constant dollars (millions)

Case A, No offsets

	NPV 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Refrigerators	193.7	6.7	18.5	38.5	28.9	47.6	53.8	44.4	39.7	34.9	29.9	24.9
Freezers	123.8	10.1	20.8	22.6	18.9	23.3	24.4	18.5	18.5	18.4	18.4	18.1
Dishwashers	38.4	0.0	0.0	9.0	13.0	13.7	14.5	11.1	11.7	12.2	12.9	13.4
Clotheswashers	157.6	0.0	0.0	48.8	31.1	33.2	38.4	31.1	31.5	31.9	32.1	32.4
Ranges	11.0	0.0	0.0	2.8	2.2	2.2	2.2	2.2	2.2	2.4	2.3	2.2
Dryers	4.6	0.0	0.0	0.0	0.1	0.4	0.9	1.2	1.4	1.9	2.2	2.5
	549.1	16.8	31.3	105.7	94.2	120.4	126.2	108.4	105.0	101.8	97.8	93.5

Lower Bound Results

Exhibits 17A through 17D, opposite, show the results of corresponding calculations for the "low energy cost" scenario. In this scenario, the costs of incremental energy equal the prices paid by the consumers.

Whereas the total savings shown in Exhibits 17A through 17D are considerably lower than in Exhibits 16A through 16D, refrigerators and freezers are exceptions in Case B (with offsets considered). The reason is the 100% load factor represented by these appliances (as a group) which makes the marginal cost of the electricity supplied to them very low, despite the high costs of new capacity. The consumer rates of electricity are, of course, based on the average load factor of the system and are, therefore, significantly higher than a rate that might be regarded as being equitable for a load with a 100% load factor.

EXHIBIT 18

PROGRAM COSTS TO SUPPORT THE ENERGUIDE PROGRAM
($000)

	FISCAL YEAR											
	77-78	78-79	79-80	80-81	81-82	82-83	83-84*	84-85*	85-86*	86-87*	87-88*	88-89*	89-90*
CSA EXPENDITURES													
1. Development and Maintenance of Standards						72	29.5	50	50	50	50	50	50
2. Labelling, Monitoring and Testing of Appliances													
2.1 Refrigerators						43.9	77.1	40	40	40	40	40	40
2.2 Freezers						56.2	32.6	35	35	35	35	35	35
2.3 Dishwashers						13.3	16.6	28	28	28	28	28	28
2.4 Clotheswashers						14.4	23.1	32	32	32	32	32	32
2.5 Electric Ranges						25.0	22.7	40	40	40	40	40	40
2.6 Electric Dryers						12.3	18.3	30	30	30	30	30	30
Sub-total						168.1	190.4	210	210	210	210	210	210
3. Directory Preparation and Printing						138.0	110.5	120	120	120	120	120	120
4. Communications						91.0	57.1	80	80	80	80	80	80
5. CSA Administration						55.6	50.9	60	60	60	60	60	60
TOTAL CSA COSTS	0	327	372	463	465	545.2	438.4	500*	500*	500*	500*	500*	500*
CCAC EXPENDITURES (Direct Labour and Travel Only)	39.6*	41.8*	44.5*	49.1*	52.6*	56.5	61.3	60.0*	60.0*	60.0*	60.0*	60.0*	60.0*
TOTAL PROGRAM COSTS	39.6	368.8	416.5	512.5	517.6	601.7	499.7	560.0	560.0	560.0	560.0	560.0	560.0
REVALUED PROGRAM COSTS ($ 1983)	72.8	626.3	652.5	710.1	634.9	654.6	499.7	560.0	560.0	560.0	560.0	560.0	560.0
PAST PROGRAM COSTS	72.8	626.3	652.5	710.1	634.9	654.6	499.7	410.0	151.0	0.0	0.0	0.0	0.0
FUTURE PROGRAM COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.0	409.0	560.0	560.0	560.0	560.0

* Estimates
Source: See Appendix A.

VII - PROGRAM COSTS

Program expenditures to support the Energuide program have been incurred since the 1977-78 Government of Canada fiscal year.

The historical program costs and available details are shown in Exhibit 18, opposite. An estimate of future program costs by CCAC to fiscal year 1989-90 in constant 1983 dollars is also shown in Exhibit 18. Program costs incurred prior to the 1983/84 fiscal year are expressed in historical dollars. Using the Gross National Expenditure Implicit Price Index for Government Current Expenditure on Goods and Services, the fiscal year costs incurred in fiscal years 1977/78 to 1982/83 have been revalued to 1983 dollars.

Program costs required to support the Energuide Program from 1977 to 1984 are referred to as "Past Program Costs". The incremental costs required to extend the current program to 1990 are shown as "Future Program Costs".

See Appendix A for additional detail.

VIII - OTHER COSTS AND BENEFITS

This Section assesses other costs and benefits associated with the Energuide Program. These are those not directly related to energy use and program costs. Impacts resulting from the "past" and "future" cases are described for the following items in turn:

- retailer costs;
- sourcing changes;
- other trade effects;
- manufacturers' costs;
- consumer search costs;
- changes in product quality.

RETAILER COSTS

Conceptually, the Energuide Program may impose incremental costs on retailers. In the normal course of events, these would be passed on to the consumer. The retailer cost study, through a series of interviews with selected retailers, attempted to define the nature of such costs and to determine their approximate magnitude (see Appendix H).

While the retailer cost study identified some factors which, in principle, might increase retailer costs, we conclude that any such costs actually incurred are insignificant. We have, therefore, assumed that retailer costs are zero.

SOURCING COSTS

In benefit-cost analysis in Canada, it is a frequent practice to revalue program impacts which result in changes in Canada's foreign exchange position.

The basis of the approach which is widely used is a paper by Jenkins*. Jenkins estimates that distortions in the foreign exchange market have a net impact in Canada of approximately 15%, i.e., the market undervalues foreign exchange by Canada in this amount. Although the figure and the approach are not universally accepted, both are widely used by the Federal Government.

The only factors affecting foreign exchange are likely to be foreign trade effects flowing from sourcing changes due to the Energuide Program. These are of two sorts:

- A change in the mix of domestically produced vs. imported finished appliances.

- Changes in the geographic sourcing of raw materials and components (and perhaps capital equipment) used by Canadian appliance manufacturers.

Finished Product

Based on the work in the appliance case studies (see Appendix G), as well as the U.S.-Canada comparison (Appendix D), we conclude that, on balance, the Energuide Program has had no impact on the mix of domestically vs. foreign-produced appliances. Consequently, there is no foreign exchange impact from this source.

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* Glen Jenkins, "Theory and Estimation of the Social Cost of Foreign Exchange Using a General Equilibrium Model with Distortions in all Markets", (Development Discussion Paper/28, Harvard Institute for International Development, May 1977).

Component Sourcing

The technology study (Appendix F) and the case studies (Appendix G) both suggest that, on balance, the Energuide Program has changed sourcing patterns in a manner which has increased the net import content of domestically-produced appliances. Two notable examples are in the refrigerator/freezer category:

- The Energuide Program appears to have accelerated the replacement of domestically produced compressors with more energy-efficient foreign produced products.

- The Program is likely to have accelerated the replacement of fibreglass insulation with various foam insulating materials. Foam insulation has a higher foreign content than fibreglass, as well as being of higher total cost.

As is discussed below, the bases of inquiry which would provide cost data related to this issue were not pursued. In the absence of detailed manufacturing cost data, we are unable to satisfactorily quantify the aggregate impact of possible changes in sourcing. An illustrative calculation suggests the orders of magnitude involved. The details are as follows:

- In 1981, approximately 822,000 refrigerators and freezers were purchased in Canada.

- Discussions with industry experts suggest that for approximately half the units produced, a shift to foreign produced compressors was accelerated by the Program, by, say, five years.

- A typical compressor costs $60 to the manufacturer, in 1983 dollars.

- Consequently, the total annual shift in foreign exchange flowing from the change in sourcing is approximately 0.5 x 822,000 x 60 = $25 million.

It is likely that this transition would have occurred in any event, but it has been accelerated by the Program, by say, five years. Consequently, the total (undiscounted) foreign exchange impact of this particular sourcing decision is approximately 5 x 25 x .15 = $19 million or $4.50 per unit sold.

While we have not made a comprehensive investigation of shifts in sourcing due to the program, it is likely that this shift in compressor sourcing is of a relatively high dollar magnitude. From discussions, we anticipate that the foreign exchange costs associated with the shift to foam insulation are of the same magnitude.

Consequently, we have made some notional estimates of foreign exchange cost associated with changes in sourcing due to Energuide. These are as follows:

- For shifts in compressors: $15 million cost in the "past", and additional $5 million in the "future".

- For foam insulation: $15 million cost in the "past", and $5 million in the "future".

These costs are attributable to refrigerators and freezers. We emphasize that these are "ballpark" estimates only, and are primarily intended to make the point that the Energuide program has resulted in some foreign exchange losses to the Canadian economy. The actual dollar magnitude should be interpreted with some caution.

Conceptually, the program may have led to incremental imports of production machinery (and of the capital to finance investment). No evidence has been collected nor estimate has been made regarding this effect.

OTHER TRADE EFFECTS

It has been suggested that the Energuide Program may have had two possible foreign trade effects, which would impact the cost benefit balance of the Program. These are:

- The Program may have fostered increased export sales of Canadian product by providing testing facilities and standardized energy consumption data, as well as encouraging the development of a more energy efficient product.

- The need for appropriate test facilities and the requirement to go through the test process, may have provided a "non-tariff" trade barrier, limiting the imports of foreign produced appliances. To some extent, this issue overlaps with the question of sourcing of finished product.

Conceptually, both of these effects may have occurred. We have found no evidence of any significant shifts, however, and it appears that any impacts are insignificant.

MANUFACTURERS' COSTS

It is reasonable to assume that most energy saving enhancements incorporated by manufacturers as a result of the Energuide Program required that some costs be borne. There are exceptions to this; it appears that new energy-efficient compressors became available to some manufacturers at essentially the same price as the more energy-intensive product which they

replaced. By and large, however, one would expect that manufacturers incurred costs as a result of participating in the Program and incorporating new features into their appliances. The types of manufacturing costs which may have been incurred include the costs of:

- installing new test facilities;
- operating the testing facilities;
- redesigning appliances;
- retooling;
- increased obsolence of appliance inventories;
- components intended to enhance energy efficiency.

Study Limitations in This Regard

During the design of the study, those lines of inquiry best suited to quantifying the extent of such cost impacts of the Program were excluded from the Terms of Reference. This decision reflected both a desire to emphasize estimates of energy savings as a key output of the study, as well as a recognition that it would be extremely difficult to generate realistic cost data within the short timeframe available.

Shifting of Costs

The evidence from the literature review (Appendix B), the U.S.-Canada comparison (Appendix D), the technology study (Appendix F) and the case studies (Appendix G) all indicate that manufacturers have incurred costs as a result of their participation in the Program and consequent incorporation of energy saving features.

In the opinion of industry participants and other experts with whom we discussed the matter, manufacturers effectively pass these costs on to consumers; in other words, pricing policies are designed to recover costs

and permit manufacturers to earn the same rates of return on capital which they would have earned in the absence of the Program.

Consumer Costs

Conceptually, in making the purchase decision, the consumer considers the life cycle costs of operating various appliances. This permits the consumer to adjust the comparison not only for operating savings, but also for additional capital costs, any perceived differences in maintenance requirements, and any differences in the useful life of the appliances. In addition, the consumer could make adjustments for any changes in the performance of the appliances, e.g., do the dishwashers get the dishes as clean in both cases?

There are concerns expressed in the industry that, in some cases, improved energy efficiency has been achieved at the expense of reduced operating characteristics in other dimensions. We are not aware of any concerns with respect to changes in the useful life or maintenance costs of individual appliances.

Discussion of Manufacturing Costs

Increases in Industry Selling Prices for major appliances exceeded both the Consumer Price (CPI) and the Gross National Expenditure Personal Expenditure on Durables Indices. This relationship was, however, also true for the 1969-1979 period.

The Canadian appliance industry has undergone considerable rationalization over the past five years. As a consequence of this rationalization, we would have expected a departure from the historical trend and seen a real price decline in the absence of the Energuide program.

In our discussions with CAMA spokesmen and industry experts, the following ranking of additional costs incurred as a result of the Energuide program is proposed:

refrigerators	(highest)
freezers	
dishwashers	
clotheswashers	
electric ranges	
electric dryers	(lowest)

One expert indicated that the Energuide program was responsible for an additional $10 at the manufacturing level for a typical refrigerator. The corresponding additional cost at the retail level would be $25 using a manufacturing-retail markup of 2.5.

Several prospective studies have been conducted to examine the issue of increased manufacturing costs resulting from the Energuide program. There continues to be considerable disagreement and controversy over the level of increased costs. Cost estimates in 1978 dollars for changes to refrigerators due to Energuide range from $56.86 (July 26, 1978 submission by CAMA to the Consumer and Corporate Affairs Canada (CCAC)) to $6.00 (May 16, 1978 CCAC). The Canadian Electric Association (CEA) made an independent assessment of the Energuide costs for refrigerators and arrived at costs in the area of $8.38 to $14.11 or an average of $10.16 per refrigerator.

A Treasury Board document "A Case Study: Energy Consumption Labelling Requirements for Refrigerators, pg.14 (See Appendix B)", illustrates estimates of the manufacturing cost and retail price increases associated with various increases in energy efficiency. The data was derived using estimates assembled for the United States Department of Energy and adjusted

EXHIBIT 19 (Continued)

IMPACT OF INCREASED MANUFACTURING COSTS
ON RETAIL SELLING PRICES
(1983 $ Millions)

MAXIMUM IMPACT

	CASE	RETAIL SELLING PRICE INCREASE (1983 $)	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Refrigerators	A	50	29.3	27.1	25.0	18.6	25.2	25.9	26.6	27.4	28.3	28.9	29.6
	B	25							13.3	13.7	14.1	14.5	14.8
Freezers	A	30	16.8	17.1	16.1	13.6	14.8	14.4	14.8	15.0	15.3	15.5	15.5
	B	15							4.4	4.5	4.6	4.7	4.7
Dishwashers	A	10			2.7	2.2	2.5	2.6	2.7	2.9	3.0	3.2	3.3
	B	5							1.4	1.5	1.5	1.6	1.7
Clotheswashers	A	10			4.8	4.0	4.7	4.8	5.0	5.1	5.2	5.3	5.4
	B	5							2.5	2.5	2.6	2.6	2.7
Electric Ranges	A	5			2.0	1.6	2.0	2.1	2.1	2.2	2.3	2.3	2.4
	B	5							2.1	2.2	2.3	2.3	2.4
Electric Dryers	A	5				1.4	1.6	1.7	1.8	1.8	1.9	1.9	2.0
	B	5							1.8	1.8	1.9	1.9	2.0
TOTAL	A	130.0	46.1	44.2	50.6	41.4	49.9	51.5	52.9	54.4	55.9	57.2	58.2
	B	60.0	0.0	0.0	0.0	0.0	0.0	0.0	25.5	26.2	27.0	27.6	28.2

NET PRESENT VALUE

SOCIAL DISCOUNT RATE

	5%	10%	15%
CASE A	418.7	323.3	257.6
CASE B	116.1	101.4	89.5

Cases

CASE A : Impact of Energuide in place to 1984 then discontinued
CASE B : Future impact of Energuide generated by continuing Energuide

EXHIBIT 19

IMPACT OF INCREASED MANUFACTURING COSTS
ON RETAIL SELLING PRICES
(1983 $ Millions)

MINIMUM IMPACT

	CASE	RETAIL SELLING PRICE INCREASE (1983 $)	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Refrigerators	A	15	8.8	8.1	7.5	5.6	7.5	7.8	8.0	8.2	8.5	8.7	8.9
	B	10							5.3	5.5	5.7	5.8	5.9
Freezers	A	15	5.0	5.1	4.8	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.7
	B	10							3.0	3.0	3.1	3.1	3.1
Dishwashers	A	0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	B	0							0.0	0.0	0.0	0.0	0.0
Clotheswashers	A	0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	B	0							0.0	0.0	0.0	0.0	0.0
Electric Ranges	A	0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	B	0							0.0	0.0	0.0	0.0	0.0
Electric Dryers	A	0				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	B	0							0.0	0.0	0.0	0.0	0.0
TOTAL	A	30.0	13.8	13.2	12.3	9.7	11.7	12.1	12.4	12.7	13.1	13.3	13.5
	B	20.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	8.5	8.7	8.9	9.0

NET PRESENT VALUE

SOCIAL DISCOUNT RATE

	5%	10%	15%
CASE A	103.9	81.2	65.4
CASE B	37.5	32.7	28.9

to account for Canadian manufacturing economics. The study shows in constant 1977 dollars assuming a retail selling price/manufacturing cost markup of 2.5 that a 3% decline in average annual energy consumption would result in a retail price increase of $1.22, a 24% decline results in a retail price increase of $28.67, etc. This study shows that a decline in energy consumption is not without costs.

Based on the above evidence and through discussions with industry experts, we havae developed some very crude estimates of Energuide-induced retail cost increases (in 1983 $) for each major appliance. We emphasize that these estimates are very preliminary and should be interpreted with caution.

Retail Price Increases Attributable to Energuide

($ 1983)

	Past Programme Onset of Labelling to 1990	Future Programme 1985 to 1990
Refrigerators	$15 - 50	$10 - 25
Freezers	$15 - 50	$ 5 - 15
Clotheswashers	$ 0 - 10	$ 0 - 5
Dishwashers	$ 0 - 10	$ 0 - 5
Ranges	$ 0 - 5	$ 0 - 5
Dryers	$ 0 - 5	$ 0 - 5

Exhibit 19, opposite, translates the ends of these ranges into net present value equivalents at various discount rates, based on the appliance volumes presented in Appendix C.

CONSUMER SEARCH COSTS

Conceptually, the Program may result in additional benefits, by providing information to consumers which permits them to reduce the time and expense required to select an appropriate appliance for purchase. We have not undertaken lines of inquiry which directly address this issue. However, based on a review of consumer market research made available to us by Consumer and Corporate Affairs, it appears that energy characteristics are relatively unimportant to consumers as they make a choice among various appliances. In addition, it appears that there is some misunderstanding among consumers as to the information which the Energuide Labelling Program conveys. Combining these two factors leads us to the view that savings in consumer search costs due to the Program are likely to be relatively insignificant.

PRODUCT PERFORMANCE

There are concerns expressed in the industry that, in some cases, improved energy efficiency has been purchased at the expense of lower operating performance. This is particularly the case with respect to:

- freezers, for which there is some concern as to the time required to freeze food;

- dishwashers, in which water temperatures may not be sufficient to melt animal fats.

In the feasibility study, this issue of product performance was not identified as a serious concern. Consequently, no lines of inquiry were identified which permit the identification and valuation of changes in product performance. However, based on discussions with the industry, it appears that a cost of the program, which has been borne by the consumer, is a deterioration in the performance of the above noted products.

EXHIBIT 20

AGGREGATE GROSS ENERGY SAVINGS*
(gigawatt-hours per year)

	Past Program		Future Program		
	1983	1989	1989		
Appliance	Base Case	Base Case	Low Case	Base Case	High Case
Refrigerators	174	92	95	119	192
Freezers	86	67	12	36	53
Dishwashers	58	57	7	25	29
Clotheswashers	138	136	3	15	30
Ranges	8	8	0	0	4
Dryers	2	9	0	2	5
Total	466	369	117	197	313

* Annual energy savings attributable to Energuide of appliances purchased in the noted years.

SOURCE: Sections II - V
Appendix J

IX - RESULTS

AGGREGATE GROSS ENERGY SAVINGS

One of the two basic objectives of the study is to provide estimates of the gross energy savings attributable to the Energuide Program, both based on its past operation, and with respect to a future extension of the Program. Exhibit 20, opposite, summarizes the estimates derived in this study for selected years.

Estimates of savings in energy consumption per unit attributable to the Program have been developed on a disaggregated basis, and weighted by historical and projected appliance sales to provide the results summarized in Exhibit 20. They do not include consideration of space heating offsets. The results in Exhibit 20 are presented in gigawatt-hours of energy saved per year, for the aggregate stock of appliances purchased in that year. They thus represent single years of an annual flow of energy savings associated with program activities. Estimates are essentially derived through the aggregation of a large number of assumptions with respect to hypothetical behaviour. There is a relatively wide range of uncertainty associated with the estimates. The detailed analyses for the base case are provided in Sections II-V, while the low and high future cases are developed in Appendix J.

Sensitivity Analysis

The base case results represent a "middle ground" or median estimate of the impact of the Program. Exhibit 20 also illustrates the sensitivity of the results to changes in assumptions with respect to the actual energy savings attributable to the Energuide Program. The base case energy saving esti-

mates are intended to represent the fiftieth percentile of the possible range of estimates of energy saving due to the Program. Low and high estimates are intended to represent the fifth and ninety-fifth percentiles of possible estimates, i.e., we are 90% confident that the "true" estimate lies between them.

VALUATION OF ENERGY SAVINGS

The gross energy savings estimates in Exhibit 20 have been valued from two perspectives:

1. A long run social cost perspective. This has involved the determination of the social costs of the incremental energy production capacity and operating costs associated with the energy savings derived from the Program. The perspective taken has been essentially that of long run marginal cost. This can be considered an "upper bound" estimate of the value of energy savings.

2. A rate-based perspective. Long run marginal costs are considerably higher than the rates paid by consumers at the present time. The "lower valuation" approach uses estimates of energy values which are essentially the rates paid by consumers at the present time. Additional conservatism is achieved by assuming no real increase in energy prices in the future, and by using social discount rates (10% real) which are considerably higher than the rates which are likely to be applied by individual consumers. Thus, this approach provides a conservative "lower bound" on energy valuation.

The valuation of energy savings, which is presented in Section VI, considers the value of the gross energy savings attributable to the Program,

EXHIBIT 21

VALUATION OF GROSS ENERGY SAVINGS
(million 1983 $)
(10% discount rate)

Appliance	Past Program NPV in 1978		Future Program NPV in 1984					
	Base Case Energy Savings		Low Case Energy Savings		Base Case Energy Savings		High Case Energy Savings	
	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
Refrigerators	238.7	193.7	56.8	46.0	108.9	88.4	175.2	142.3
Freezers	154.7	123.8	8.3	6.6	39.1	31.2	52.1	41.5
Dishwashers	280.9	58.4	15.1	3.2	90.8	18.8	103.6	21.4
Clotheswashers	579.6	157.6	5.9	1.6	27.8	7.7	54.9	15.2
Ranges	43.5	11.0	0.0	0.0	0.0	0.0	7.7	2.5
Dryers	14.6	4.6	0.0	0.0	4.0	1.3	9.5	3.1
Total	1,312.1	549.1	86.1	57.4	270.6	147.4	403.0	226.0

SOURCE: Section VI
Appendix J

as well as allowances for home heating offsets. For the labelled appliances, the reduction in energy usage during the winter months creates a requirement for additional energy consumed by the home heating system, in order to maintain temperature levels in the home. From both the private consumer perspective and from the social perspective, the additional costs of providing home heating energy due to reductions in energy use by appliances should be taken into account.

Exhibit 21, opposite, summarizes the results of the valuation of gross energy savings. Exhibit 22, overleaf, summarizes the results of the valuation of energy savings, taking into account home heating offsets. Exhibits 21 and 22 present the net present value of energy savings attributable to the Program under the "past" and "future" cases. In all cases, it is assumed that appliance purchased have a useful operating life of 15 years. Energy savings are discounted at a real social discount rate of 10%. (Sensitivities to discount rate are discussed below.) Only appliances manufactured and sold before the year 1990 are considered in the analysis.

PROGRAM COSTS

Program costs are presented in Section VII. In summary, the net present value of program costs (in 1983 $ and at a 10% discount rate) is as follows:

- For the past program, the NPV is $3.0 million (in 1978).
- For the future program, the NPV is $1.6 million (in 1984).

OTHER COSTS TO BE CONSIDERED

There are a number of other types of cost to society which should be considered. These are discussed in Section VIII. Based on this work in this engagement, several of these appear to be insignificant. These are:

EXHIBIT 22

VALUATION OF NET ENERGY SAVINGS
NET OF OFFSETS
(million 1983 $)
(10% discount rate)

	Past Program NPV in 1978		Future Program NPV in 1984					
	Base Case Energy Savings		Low Case Energy Savings		Base Case Energy Savings		High Case Energy Savings	
Appliance	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
Refrigerators	102.5	111.6	24.4	26.5	46.8	50.9	75.3	81.9
Freezers	65.6	68.2	3.6	3.6	16.6	17.2	22.1	22.9
Dishwashers	175.2	52.8	9.4	2.9	58.7	17.1	64.7	19.5
Clotheswashers	404.4	153.8	4.1	1.6	19.4	7.5	38.3	14.9
Ranges	26.9	6.4	0.0	0.0	0.0	0.0	7.1	2.3
Dryers	13.7	4.3	0.0	0.0	3.7	1.2	8.8	2.8
Total	788.4	397.1	41.5	34.6	143.2	93.9	216.3	144.3

SOURCE: Section VI
Appendix J

- additional costs incurred by retailers;
- changes in the sourcing of finished appliances between Canada and import products;
- savings in consumer search costs due to the Program;
- costs or benefits associated with foreign trade effects resulting from the Program.

However, two categories of costs appear to be quantitatively significant.

- Changes in sourcing of components. Benefit-cost studies undertaken by the Federal Government frequently compute an adjustment for the value to society of foreign exchange saved or spent. From this perspective, increased import content results in a loss of foreign exchange and an associated cost to Canadian society. The Program appears to have increased the import content of the components going into domestically-manufactured appliances. Two examples are the shift from domestically produced to foreign-produced compressors, and the shift from fiberglass insulation to foam insulation.

- Additional costs to the consumer. The incorporation of energy saving features in response to the Energuide Program has resulted in some increases in manufacturing costs of the labelled appliances. It appears that these costs have essentially been shifted to the consumer, in the form of higher product prices. The benefit-cost analysis offsets the value of energy savings with an estimate of the value of the additional resources which were required to

EXHIBIT 23

COMPONENTS OF COSTS AND BENEFITS
PAST CASE
(million 1983$ - NPV in 1978)

	Base Case Energy Savings		
	5% Rate	10% Rate	15% Rate
ENERGY BENEFITS			
Value of Net Energy Benefits	723-1134	397-788	235-576
RESOURCE COSTS			
Program Costs			
Sourcing of Finished Products	3	3	3
Sourcing of Components	15	15	15
Retailer Costs	-	-	-
Consumer Search Costs	-	-	-
Passed-on Manufacturers' Costs	104-413	81-323	65-258
Product Performance	-	-	-
Foreign Trade Effects	-	-	-
Value of Resource Costs	122-437	99-341	83-276
Net Benefit (Cost)	286-1012	56-689	(23)-493
Benefit/Cost Ratio	1.65-9.30	1.16-7.96	0.85-6.94

achieve these savings, and which have been passed onto the customer. However, the available timeframe did not permit the inclusion in the Terms of Reference of lines of inquiry which would permit a satisfactory quantitative assessment of this issue. We have addressed the issue through very broad estimates of the extent of incremental consumer cost borne by consumers on an appliance-by-appliance basis. These estimates should be interpreted with caution.

Another category of costs which might be considered relates to changes in product performance as a consequence of Energuide. This type of cost was not clearly addressed in the feasibility study, and we have not pursued lines of inquiry to permit us to value changes in product performance. However, during the course of the study, we received many comments expressing concern with respect to deterioration in product performance due to the manufacturers' attempts to lower energy consumption characteristics of their products. These are particularly of concern with respect to freezers and dishwashers.

BENEFIT-COST RESULTS

Exhibit 23, opposite, and Exhibit 24, overleaf, provide the basic results of the benefit-cost analysis. Exhibit 23 deals with the "past" Program, and Exhibit 24 deals with the "future" Program. The results are presented with a range of social discount rates; it is intended that the 10% rate serve as the base case.

CONCLUSIONS AND GUIDELINES FOR INTERPRETATION

This study has developed a framework for assessing the benefit-cost relationship of the Energuide Program, both in the past, and with respect to

EXHIBIT 24

COMPONENTS OF COSTS AND BENEFITS
FUTURE CASE
(million 1983$ - NPV in 1984)

	Base Case Energy Savings		
	5% Rate	10% Rate	15% Rate
ENERGY BENEFITS			
Value of Net Energy Benefits	149-173	94-143	63-122
RESOURCE COSTS			
Program Costs	2	2	2
Sourcing of Finished Products	-	-	-
Sourcing of Components	5	5	5
Retailer Costs	-	-	-
Consumer Search Costs	-	-	-
Passed-on Manufacturers' Costs	38-116	33-101	29-89
Product Performance	-	-	-
Foreign Trade Effects	-	-	-
Value of Resource Costs	45-123	40-108	36-96
Net Benefit (Cost)	26-128	(14)-103	(33)-66
Benefit/Cost Ratio	1.21-3.84	0.87-3.58	0.66-3.39

possible Program extensions in the future. The methodologies employed do not permit satisfactory quantification of all of the important costs associated with the Program, and thus the results must be interpreted with considerable caution.

In this context, the study findings are as follows:

- The Energuide Program appears to have had a significant impact on gross energy savings in the past, and could be expected to have significant impact in the future.

- The quantitative estimates of benefits and costs are highly sensitive to changes in assumptions with respects to energy utilization and energy valuation.

- Depending on the range of assumptions chosen, net Program benefits vary considerably:

    - for the past, net benefits vary from $56 million to $689 million, and benefit-cost ratios from 1.2 to 8.0

    - for the future, net benefits range from minus $14 million to plus $103 million, and benefit-cost ratios from 0.9 to 3.6.

    - net benefits are higher at discount rates of 5% and lower at 15%.

ANNEX 1

TERMS OF REFERENCE

TERMS OF REFERENCE FOR A BENEFIT-COST STUDY OF THE ENERGUIDE PROGRAM

PURPOSE

This study is expected to determine the benefit-cost of the Energuide Program as part of an April 30 submission to the Treasury Board. This benefit-cost analysis may form part of a longer, and more intensive analysis, as part of the evaluation study of the Energuide Program.

OBJECTIVE

The two major objectives of this project are to measure the energy saving attributable to Energuide and to estimate costs and benefits incurred as a result of the Energuide Program.

SCENARIOS

Costs and benefits are to be evaluated according to two scenarios: a past scenario from 1976/77 to 1985/1986 and a future scenario from 1985/86 to 1989/90 which would compare a world with and without the Energuide Program.

RESEARCH QUESTIONS TO DETERMINE BENEFITS AND COSTS

The contractor is required to answer the following research questions:

(a) Actual Sales of Appliances - including sales of appliances by energy characteristics and the portion of total demand stimulated because of energy efficiency improvements in appliances.

(b) Actual Energy Use of Appliances.

(c) Hypothetical Sales of Appliances had the Energuide Program not existed and hypothetical sales of appliances in the future.

(d) Hypothetical Energy Use for each appliance for each of the hypothetical scenarios, past and future.

.../2

(e) Actual Manufacturing Costs incurred by appliance manufacturers which have occurred as a direct consequence of the Energuide program.

(f) Hypothetical Manufacturing Costs which will be incurred if the Energuide Program is continued to 1990.

(g) Actual Retailer Costs incurred because of the Energuide Program.

(h) Hypothetical Retailer Costs which will be incurred if the Energuide Program is continued to 1990.

(i) Costs or Benefits to Canada because of changes in the sourcing of components and finished goods both in the past and future scenarios.

(j) Impacts of Other Trade effects, both past and future, which are attributable to the Energuide Program.

(k) Program Costs, both past and future, of the Energuide Program.

(l) Discount Rates, social costs, space heating offsets, values in order to value the costs and benefits arising from the Energuide Program and to discount these costs and benefits.

LINES OF INQUIRY TO BE EMPLOYED

The contractor agrees to employ the following lines of inquiry in quantifying the impact of the Research Questions. These areas of inquiry determine the emphasis to be placed on individual research questions:

(a) Consult program files to determine the costs of the Energuide Program.

(b) Review the current literature to determine trends in energy utilization of appliances and valuation issues.

(c) Utilize Statistics Canada and CAMA publications to determine appliance sales (past and future) and to measure the impact of the Program on appliance pricing.

.../3

(d) Compare U.S. and Canadian energy utilization rates to develop the past and future energy utilization scenarios.

(e) Utilize the Energuide Directory to determine the energy utilization changes in major appliances during the life of the Energuide Program.

(f) Consult experts to determine the hypothetical energy consumption of appliances and the incremental future manufacturing costs resulting from the Energuide Program.

(g) Construct case studies for refrigerators and dishwashers to examine in detail the hypothetical trends in energy consumption.

(h) Obtain specific discount rates and values to revalue costs and benefits from the Treasury Board.

(i) Interview ITC officials to determine impacts of sourcing changes and interview EMR and CMHC officials to determine what space heating offsets and energy costs to use.

(j) Interview selected major retailers to determine the past and future costs (if any) resulting from the Energuide Program.

(k) Through interviews and literature review, to determine the extent to which additional energy savings are technically feasible.

ANALYSIS

The researcher is to employ the lines of inquiry outlined to measure the costs and benefits arising from each of the research questions. The streams of incremental annual costs and benefits which arise from each scenario are then to be revalued to reflect social costs, etc., and discounted by appropriate discount rates to develop benefit-cost ratios.

A sensitivity analysis is to be performed with costs, benefits and discount rates varied to test the stability of the calculated benefit-cost ratios.

The researcher is to clearly identify any assumptions made while conducting the cost benefit study. The research will also discuss the implications of changing the basic assumptions and their effect on the analysis.

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EXPECTED REPORTS

An interim and a final report will be submitted to CCAC. The reports will contain the following:

(a) The interim report will outline the progress of the researchers to date and will describe the possible data problems and constraints that will affect the analysis. It will also outline the methods to be used to address the aforementioned research questions.

(b) The final report will provide a comprehensive analysis of all the benefits and costs of the Energuide Program in the past and in the future. The final report will document the assumptions and limitations of the benefits and costs measured, and will report on the sensitivity of the benefit-cost ratios to changes in costs, benefits and discount rates.

TIMING

Work on this project will begin as soon as a letter of agreement has been signed.

Submission and presentation of interim report March 9, 1984.

Submission and presentation of final report March 30, 1984.

CONSULTATION

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APPENDICES

EXHIBIT A-1

PROGRAM COSTS TO SUPPORT THE ENERGUIDE PROGRAM
($000)

	FISCAL YEAR											
	77-78	78-79	79-80	80-81	81-82	82-83	83-84*	84-85*	85-86*	86-87*	87-88*	88-89*	89-90*
CSA EXPENDITURES													
1. Development and Maintenance of Standards						72	29.5	50	50	50	50	50	50
2. Labelling, Monitoring and Testing of Appliances													
2.1 Refrigerators						43.9	77.1	40	40	40	40	40	40
2.2 Freezers						58.2	32.6	35	35	35	35	35	35
2.3 Dishwashers						13.3	16.6	28	28	28	28	28	28
2.4 Clotheswashers						14.4	23.1	32	32	32	32	32	32
2.5 Electric Ranges						25.0	22.7	40	40	40	40	40	40
2.6 Electric Dryers						12.3	18.3	30	30	30	30	30	30
Sub-total						166.1	190.4	210	210	210	210	210	210
3. Directory Preparation and Printing						138.0	110.5	120	120	120	120	120	120
4. Communications						91.0	57.1	60	60	60	60	60	60
5. CSA Administration						55.6	50.9	60	60	60	60	60	60
TOTAL CSA COSTS	0	327	372	483	465	545.2	438.4	500*	500*	500*	500*	500*	500*
CCAC EXPENDITURES (Direct Labour and Travel Only)	39.6*	41.8*	44.5*	49.1*	52.6*	56.5	91.3	60.0*	60.0*	60.0*	60.0*	60.0*	60.0*
TOTAL PROGRAM COSTS	39.6	368.8	416.5	512.5	517.6	601.7	489.7	560.0	560.0	560.0	560.0	560.0	560.0
REVALUED PROGRAM COSTS ($ 1983)	72.8	626.3	652.5	710.1	634.9	654.6	499.7	560.0	560.0	560.0	560.0	560.0	560.0
PAST PROGRAM COSTS	72.8	626.3	652.5	710.1	634.9	654.6	499.7	410.0	151.0	0.0	0.0	0.0	0.0
FUTURE PROGRAM COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.0	409.0	560.0	560.0	560.0	560.0

* Estimates
Source: Canadian Standards Association and Consumer and Corporate Affairs Canada

APPENDIX A
PROGRAM COSTS

Program expenditures to support the Energuide program have been incurred since the 1977-78 Government of Canada fiscal year. The costs incurred have been of two types:

- costs associated with one post within Consumer and Corporate Affairs Canada (CCAC); and

- contracted costs with the Canadian Standards Association (CSA) to develop and maintain the Energuide standards, to label, monitor and test appliances, to prepare the Energuide Directories and to prepare a communications program.

The program costs required to support the Energuide program from 1977 to 1984 are shown in Exhibit A-1, opposite, as Past Program Costs. The incremental program costs required to continue the current Energuide program from 1985 to 1990 are shown as Future Program Costs. The historic program costs have been revalued to constant 1983 dollars using the Gross National Expenditure Implicit Price Index for Government Current Expenditure on Goods and Services (CANSIM 40631). Estimated future program costs to fiscal year 1989-90, provided by CCAC, are in constant 1983 dollars.

EXHIBIT B-1

TYPICAL 1978/79 ENERGY CONSUMPTION VALUES AND FORECASTS OF TECHNICALLY POSSIBLE IMPROVEMENTS

	1978/79 Base Consumption (kwh/mo.)		Technically Possible Improvements			
			CEA		CAMA	
	CEA (Drapkin)	CAMA (Lane)	%	kwh/mo.	%	kwh/mo.
1. Refrigerators (Fiberglass Insulation)						
- Manual Defrost (10 cu.ft.)	-	60	-	-	31	18
- 2-Door Frost-Free						
. 15 cu.ft.	-	164	-	-	39	64
. 16 cu.ft.	133	-	39	52	-	-
2. Chest Freezer (Fibreglass Insulation)						
12 cu.ft.	108	108	25	27	47	51
3. Dishwashers	176	140	23	40.3	17.7	25
4. Clothes washers	132.5	161	64	84.8	26	42
5. Electric Ranges						
- Self Clean	-	67	-	-	2.9	1.95
- Non-Self Clean	-	70.5	-	-	7.7	5.45
- Average	79	-	48	37.8	-	-
6. Dryer	83.3	-	5	4.2		

SOURCE: See Text

APPENDIX B
LITERATURE REVIEW

The literature review was conducted to review the hypothetical energy consumption levels which various authors have claimed are technically possible and to review the actual energy consumption trends as viewed by other experts.

HYPOTHETICAL ENERGY CONSUMPTION

The CEA Report "Energy Analysis of Major Household Appliances", May 1981, and the CAMA "Technical Response to the CEA Report", October 1981, have provided estimates of the energy consumption impacts of technically possible design changes for various appliances. The estimates are shown in Exhibit B-1, opposite.

The consensus of the experts surveyed is that the CAMA report is more realistic since it is based on more current information. Furthermore, some of the energy-saving proposals contained in the CEA report did not consider the impact the proposals would have on product performance and consumer acceptance of the changes.

ACTUAL ENERGY CONSUMPTION

There is very little data on the actual energy consumption of major appliances in 1978/79. The CEA report and the CAMA reports of 1981 have indications of what the "typical" appliance consumption was in 1978/79. These "typical" consumption values are shown in Exhibit B-1.

Appliance consumption values have fallen since the onset of the Energuide program. A graphical illustration from the 1981 CAMA report, Exhibit B-2, overleaf, illustrates how refrigeration efficiencies have improved. The

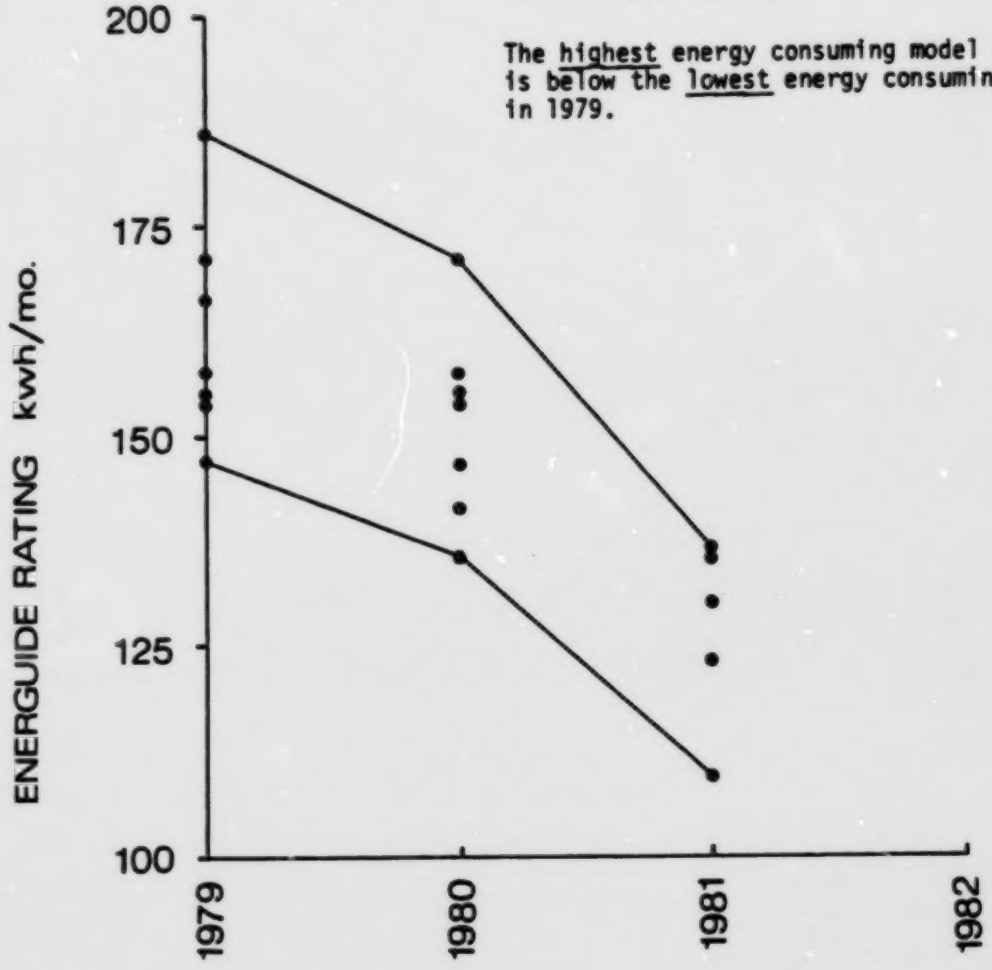
EXHIBIT B-2

ENERGY CONSUMPTION IMPROVEMENTS ENERGUIDE RATINGS

FROST FREE REFRIGERATOR-FREEZERS WITH TOP MOUNT FREEZER -- 14.5 TO 15.5 CU. FT.

Since the introduction of the Energuide labelling programme for refrigerators in 1979 the average energy consumption has fallen significantly.

The highest energy consuming model in 1981 is below the lowest energy consuming model in 1979.



Source: CAMA Technical Response to the CEA Report, October, 1981

EXHIBIT B-3

AVERAGE ENERGY CONSUMPTION REDUCTION. MAJOR HOUSE APPLIANCES

	BASE YEAR (2) kwh/mo	1983 (3) kwh/mo	REDUCTION kwh/mo	ANNUAL SAVING (4) $	PREDICTED 5 YEAR REDUCTION (5) kwh/mo
REFRIGERATOR (1)	164	122	42	20.16	64
DISHWASHER	140	102	38	18.24	25
CLOTHES WASHER	161	107	54	25.92	42
RANGE	67	65	2	0.96	5

NOTES:
1. 15 cu.ft. top freezer, frost-free refrigerator.
2. Energy consumption of unimproved product prior to Energuide labelling, see CAMA response to CEA Appliance Energy Analysis, March 1981.
3. Averaged from data in 1983 Energuide Directory.
4. Energy cost $0.04/kwh.
5. Reduction predicted to be achieved by 1986 in CAMA response to CEA Analysis.

RIL
Feb. 1, 1984

Source: R.Lane, CAMA

Exhibit also shows that the range between the lowest and highest efficiency refrigerators is narrowing.

In February 1984, R. Lane prepared a table, (see Exhibit B-3, opposite), stating the CAMA view of the level of energy efficiency attained in the 1983 model year. For the four appliances shown, the energy efficiencies have improved - some dramatically.

Anderson and Claxton

The 1981 C. Anderson and J. Claxton report outlined some of the changes to refrigerators and freezers which took place in the early years of the program.

Some changes to Frost Free Refrigerators for some models included:

- a change from fibreglass to foam insulation;
- the addition of an energy saver switch;
- a speeding up of energy changes due to the knowledge of impending ENERGUIDE regulations;
- change to more efficient compressors;
- an engineering design change to move to a thicker foam than originally anticipated resulting in further savings ranging from 9-30%.

Changes to some freezer models included:

- an increase in foam insulation thickness from 2" to 2 1/2" reducing the Energuide rating by 15%;

- a reduction in compressor size;
- a reduction in the Energuide rating of 40 KWH/mo. (39%) for a 12 cu. ft. freezer instead of a planned 10% in the absence of Energuide;
- an increase in compressor efficiency.

Tyfos and Fenwick

The 1982 Report "An Interim Assessment of the Energuide Program" provides a further assessment of the actual improvement in the energy efficiencies of major appliances. The following comments were made:

- Ranges. Ranges launched in 1982 were .37 KWH/mo. more efficient than pre-1982 models. The improvement in 1982 models was primarily in self-clean models.
- Dishwashers. Dishwashers introduced in 1982 were more efficient than 1981 models. Because of an overall trend to lower hot water usage, 1982 models are 7% more energy efficient than the 1981 average. Major efficiency gains were made prior to the Energuide program.
- Clotheswashers. Major gains were made prior to the Energuide program. The 1982 estimate of energy consumption for clotheswashers is 100.2 KWH/mo.
- Freezers. The report stated that:

> "Manufacturers of freezers have reduced the energy consumption of comparable models in every

year of the Energuide Program. However, the greatest improvement apparently occurred just before the Program was implemented. Energy usage of comparable models fell by 44% from 1979 to 1982, in contrast to an average fall of only 16% from 1980 to 1982 (the period for which the Energuide program was actually applied to freezers). Efficiency gains made before 1980 are probably not independent of the Energuide Program. Awareness of the forthcoming Directory may well have stimulated the introduction of energy efficient features."

- Refrigerators. Refrigerators introduced in 1982 were on average 19% more efficient than pre-1980 models. Efficiency gains were greatest for the frost-free refrigerators. The efficiency gains for manual defrost refrigerators were relatively modest.

LITERATURE REVIEWED

Major Literature Reviewed

1. Claxton, J.D., Anderson, C.D., Producer, Retailer and Consumer Perspectives on Canada's Energy Labelling Program for Major Appliances, February, 1981.

2. R. Drapkin, Ontario Hydro, Energy Analysis of Major Household Appliances, prepared for the CEA, March, 1981.

3. Peter Tyfos and Ian Fenwick, An Interim Assessment of the Energuide Program, August, 1982.

4. Roger I. Lane, Technical Response to the CEA Report "Energy Analysis of Major Household Appliances", October, 1981.

Other Literature Sources Reviewed

1. Ron Hirshhorn, Working Paper No. 1, A Case Study of the Proposals for Energy Consumption Labelling of Refrigerators, Economic Council of Canada, October 1978.

2. Harry Chernoff, Individual Criteria for Energy-Related Durables: The Misuse of the Life Cycle Cost, The Energy Journal, Volume 4, Number 4, October 1983.

3. Can-Do Consultants Inc., Strategy Recommendations and Research Study, prepared for the Canadian Standards Association, March 1983.

4. Yehuda Kotowitz, A Pre-Evaluation Assessment of the Energuide Program, Department of Consumer and Corporate Affairs, 1981.

5. C. Dennis Anderson and R. Bruce Hutton, Life Cycle Costing: A Review and Evaluation, Consumer and Corporate Affairs Canada (Working Paper), March 1980.

6. C. Dennis Anderson and R. Bruce Hutton, Consumer Response to Life Cycle Cost and Various Mandated Appliance Energy Label Formats: A Field Experiment, Department of Consumer and Corporate Affairs Canada, September 1980.

7. Ronald Hirshhorn, A Case Study: Energy Consumption Labelling Requirements for Refrigerators, Treasury Board Canada and Consumer and Corporate Affairs Canada, 1979.

8. J.M. Bell and W.R. Jones, The Potential for Energy Conservation in Major Electrical Appliances, prepared for the Canadian Electrical Association by Ontario Hydro, April 1982.

EXHIBIT C-1

Appliance Sales - Historical and Projected
(000 Units)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Refrigerators	616	586	542	499	372	503	518	532	548	565	578	592
Freezers	318	335	341	322	272	279	288	295	300	305	310	310
Dishwashers	291	333	308	274	215	246	262	274	291	303	320	332
Clotheswashers	558	537	534	484	484	465	481	496	508	520	529	539
Electric Ranges	500	470	430	402	315	404	414	426	440	455	468	481
Electric Dryers	389	380	375	341	277	325	341	353	363	375	385	395
TOTAL	2680	2641	2530	2322	1855	2222	2304	2376	2450	2523	2590	2649

Source: Canadian Appliance Manufacturers Association, Industry Forecast 1984

APPENDIX C
REVIEW OF CAMA DATA

The Canadian Appliance Manufacturers Association (CAMA) annually prepares a forecast of appliance sales. The sales forecast for each of the six major appliances covered by Energuide, as well as historical sales since 1978, are shown in Exhibit C-1, opposite.

CAMA also publishes and prepares analyses of more detailed market segments for most major appliances. Detailed segmented information for selected appliances is shown in Exhibit C-2, overleaf. The appliance segment information is applied to the Energuide ratings developed in Appendix E for the same segment to calculate accurate weighted Energuide ratings for each major appliance.

Provincial shares of appliance sales are to be found in Exhibit C-3, overleaf. These shares for each appliance are used to calculate the total energy saved for each appliance in each province. The 1984 to 1989 provincial shares were set equal to the average of the 1979 to 1983 provincial shares of appliance sales. No adjustment for population shifts has been made since current provincial population projections are in doubt.

EXHIBIT C-2

DETAILED APPLIANCE SEGMENT INFORMATION

Sales Percentages in each Category

REFRIGERATORS

Volume (Cu. Ft.)	1978	1979	1980	1981	1982	1983
Manual Defrost						
<8.5	16.5%	20.0%	17.0%	16.0%	8.0%	9.0%
8.5-9.4	1.9%	1.0%	2.0%	2.0%	8.0%	8.0%
9.5-10.4	39.9%	43.0%	47.0%	52.0%	63.0%	67.3%
10.5-11.4	3.7%	3.0%	3.0%	4.0%	1.0%	8.0%
11.5-12.4	12.0%	9.0%	9.0%	6.0%	6.0%	4.0%
12.5-13.4	12.0%	13.0%	12.0%	11.0%	17.0%	16.3%
13.5+	13.3%	11.0%	10.0%	10.0%	13.0%	11.6%
Other 1 Dr						
<13.5	100.0%	63.0%	39.0%	37.0%	30.0%	33.0%
>13.5		37.0%	61.0%	63.0%	70.0%	67.0%
2-Dr Frost Free Top Freezer						
<13.5	23.0%	19.9%	18.4%	19.0%	19.0%	18.6%
13.5-14.5	10.3%	14.5%	12.0%	13.0%	17.7%	15.7%
14.5-15.49	25.2%	27.6%	26.4%	24.9%	27.0%	23.2%
15.5-17.5	31.7%	36.0%	39.7%	40.9%	34.1%	41.3%
>17.5	1.0%	1.3%	2.5%	1.3%	1.5%	1.2%
Frost Free, Side x Side						
<17.5	4.0%	3.0%	0.0%	0.0%	0.0%	0.0%
17.5-19.5	79.0%	83.0%	76.0%	88.0%	93.0%	94.0%
>19.5	17.0%	14.0%	24.0%	12.0%	7.0%	6.0%

FREEZERS

	1978	1979	1980	1981	1982	1983
Chest Freezer						
<14.0	54.0%	58.3%	61.0%	65.0%	75.0%	72.0%
14-17.99	20.0%	18.2%	12.0%	17.0%	12.0%	13.0%
18-22.9	21.0%	19.2%	20.0%	9.0%	8.0%	9.0%
>23.0	5.0%	4.3%	7.0%	9.0%	5.0%	6.0%
Upright Freezer						
<14.0	46.0%	46.0%	46.0%	46.0%	46.0%	46.0%
14-17.5	54.0%	54.0%	54.0%	54.0%	54.0%	54.0%

EXHIBIT C-2 (Continued)

DETAILED APPLIANCE SEGMENT INFORMATION

Sales Percentages in each Category

Refrigerators	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Manual Defrost	23.2%	20.2%	19.1%	18.0%	15.3%	10.5%	10.6%	10.7%	10.9%	11.0%	11.1%	11.2%
Other 1 DR	0.9%	1.3%	2.1%	2.0%	2.1%	3.0%	2.8%	2.7%	2.5%	2.3%	2.2%	2.0%
2 Dr FF Top Frez.	67.1%	70.6%	70.7%	71.5%	74.8%	77.8%	77.7%	77.7%	77.6%	77.5%	77.5%	77.4%
FF S x S	4.8%	5.5%	6.5%	7.4%	7.1%	7.7%	7.9%	8.1%	8.2%	8.4%	8.6%	8.8%
SUB-TOTAL	96.0%	97.6%	98.4%	98.9%	99.3%	99.0%	99.1%	99.2%	99.2%	99.2%	99.4%	99.4%
Freezers												
Chest	92.0%	91.7%	91.0%	91.0%	90.0%	91.0%	90.3%	89.7%	89.0%	88.3%	87.7%	87.0%
Upright	8.0%	8.3%	9.0%	9.0%	10.0%	9.0%	9.7%	10.3%	11.0%	11.7%	12.3%	13.0%
Ranges												
30" Self Clean	21.8%	26.1%	28.3%	29.4%	26.6%	24.5%	25.6%	26.7%	27.7%	28.7%	29.8%	30.8%
30" Regular	58.0%	57.5%	56.3%	57.9%	55.6%	62.0%	60.5%	58.9%	57.5%	56.0%	54.6%	53.1%
24" Regular	20.2%	16.4%	15.4%	15.5%	13.9%	13.5%	13.9%	14.4%	14.8%	15.2%	15.7%	16.1%
Dryers												
Timed	34.5%	34.5%	34.5%	33.9%	33.3%	30.3%	30.1%	29.9%	29.6%	29.4%	29.2%	29.0%
Auto-Temp	60.5%	60.5%	60.5%	61.1%	61.6%	64.3%	64.5%	64.7%	64.9%	65.1%	65.3%	65.5%
Auto-Moisture	5.0%	5.0%	5.0%	5.0%	5.1%	5.4%	5.4%	5.4%	5.5%	5.5%	5.5%	5.5%

Source: CMA Industry Forecast 1984, Peat Marwick Interpolations

EXHIBIT C-3

PROVINCIAL SHARES OF APPLIANCE SALES

PROVINCIAL SALES PERCENTAGES
Refrigerators

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Atlantic		6.4%	5.8%	4.9%	6.7%	6.4%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
Quebec		26.7%	26.5%	25.7%	25.1%	24.1%	25.6%	25.6%	25.6%	25.6%	25.6%	25.6%
Ontario		35.0%	33.7%	35.6%	32.9%	40.1%	35.5%	35.5%	35.5%	35.5%	35.5%	35.5%
Manitoba		5.0%	4.7%	4.4%	3.8%	4.4%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Saskachewan		3.6%	3.1%	3.5%	3.4%	3.7%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Alberta		12.6%	13.3%	13.5%	15.9%	10.7%	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%
British Columbia		10.7%	12.9%	12.4%	12.2%	10.6%	11.8%	11.8%	11.8%	11.8%	11.8%	11.8%

PROVINCIAL SALES PERCENTAGES
Freezers

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Atlantic		6.6%	5.1%	4.4%	5.3%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%
Quebec		16.2%	16.8%	15.8%	18.4%	19.5%	17.3%	17.3%	17.3%	17.3%	17.3%	17.3%
Ontario		49.8%	51.8%	53.5%	49.3%	50.6%	51.8%	51.8%	51.8%	51.8%	51.8%	51.8%
Manitoba		8.9%	6.9%	8.3%	7.8%	7.2%	7.8%	7.8%	7.8%	7.8%	7.8%	7.8%
Saskachewan		2.1%	3.1%	3.7%	5.0%	4.4%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%
Alberta		8.9%	7.7%	6.8%	5.3%	5.8%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%
British Columbia		7.5%	8.6%	7.5%	8.9%	7.1%	7.9%	7.9%	7.9%	7.9%	7.9%	7.9%

EXHIBIT C-3 (Continued)

PROVINCIAL SHARES OF APPLIANCE SALES

PROVINCIAL SALES PERCENTAGES
Dishwashers

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Atlantic		3.8%	3.5%	3.3%	4.2%	3.6%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%
Quebec		28.5%	28.1%	23.2%	24.5%	24.8%	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%
Ontario		27.0%	26.3%	28.9%	32.3%	35.6%	30.1%	30.1%	30.1%	30.1%	30.1%	30.1%
Manitoba		6.7%	4.9%	5.8%	4.8%	4.2%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%
Saskachewan		3.9%	3.8%	4.9%	4.4%	4.8%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Alberta		17.5%	17.2%	17.4%	18.8%	14.4%	16.9%	16.9%	16.9%	16.9%	16.9%	16.9%
British Columbia		12.6%	15.6%	17.3%	12.6%	12.6%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%

PROVINCIAL SALES PERCENTAGES
Clotheswashers

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Atlantic		7.7%	7.8%	6.5%	7.5%	6.8%	7.1%	7.1%	7.1%	7.1%	7.1%	7.1%
Quebec		28.1%	27.5%	25.1%	27.8%	27.1%	27.1%	27.1%	27.1%	27.1%	27.1%	27.1%
Ontario		32.6%	32.2%	35.8%	34.1%	38.4%	34.6%	34.6%	34.6%	34.6%	34.6%	34.6%
Manitoba		5.2%	4.3%	4.4%	4.8%	3.9%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Saskachewan		3.7%	3.7%	4.8%	4.2%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%
Alberta		11.6%	12.4%	12.9%	11.8%	10.2%	11.8%	11.8%	11.8%	11.8%	11.8%	11.8%
British Columbia		11.1%	12.9%	11.3%	10.6%	9.7%	11.1%	11.1%	11.1%	11.1%	11.1%	11.1%

EXHIBIT C-3 (Continued)

PROVINCIAL SHARES OF APPLIANCE SALES

PROVINCIAL SALES PERCENTAGES
Electric Ranges

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Atlantic		6.8%	6.8%	5.8%	6.7%	7.6%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%
Quebec		26.1%	27.1%	24.9%	25.1%	25.5%	25.7%	25.7%	25.7%	25.7%	25.7%	25.7%
Ontario		33.7%	32.8%	35.4%	32.9%	37.3%	34.4%	34.4%	34.4%	34.4%	34.4%	34.4%
Manitoba		4.9%	4.3%	4.1%	3.8%	4.2%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%
Saskachewan		4.1%	3.3%	3.3%	3.4%	3.6%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Alberta		13.3%	13.1%	14.6%	15.9%	11.1%	13.6%	13.6%	13.6%	13.6%	13.6%	13.6%
British Columbia		11.1%	13.4%	12.7%	12.2%	10.7%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%

PROVINCIAL SALES PERCENTAGES
Electric Dryers

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Atlantic		8.0%	6.9%	6.1%	7.0%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%
Quebec		28.5%	28.1%	24.6%	27.6%	27.3%	27.2%	27.2%	27.2%	27.2%	27.2%	27.2%
Ontario		38.5%	38.4%	34.7%	32.9%	36.9%	33.1%	33.1%	33.1%	33.1%	33.1%	33.1%
Manitoba		5.8%	4.2%	4.5%	3.9%	4.1%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Saskachewan		3.6%	3.9%	4.0%	4.4%	4.4%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%
Alberta		12.2%	12.9%	14.2%	13.2%	11.2%	12.7%	12.7%	12.7%	12.7%	12.7%	12.7%
British Columbia		11.4%	13.6%	11.9%	11.0%	10.1%	11.6%	11.6%	11.6%	11.6%	11.6%	11.6%

Source: CAMA Industry Forecast 1984 and Peat Marwick Projections

APPENDIX D
U.S./CANADA COMPARISON

The United States, like Canada, has an energy consumption labelling program for major appliances. U.S. exports of major appliances and the strong corporate ties of the major Canadian firms with American firms would have had some impact on the overall energy consumption in Canada. A study of the U.S. experience is useful in developing scenarios of what the Canadian energy consumption values would be and would have been in the absence of the Energuide Program. The comparison is also useful to obtain assessments of possible trends in the applications of new technology to major appliances.

ENERGYGUIDE PROGRAM

The U.S. has an energy efficiency labelling program with a similar intent to the Canadian program: to reduce the energy consumption of major appliances. The aims of the U.S. ENERGYGUIDE program are to:

- reduce the imports of foreign oil (17% of U.S. electricity is oil-generated)

- reduce energy consumption in total.

The ENERGYGUIDE Program includes refrigerators, freezers, dishwashers, water heaters, clothes washers, room air conditioners and furnaces. Electric ranges and clothes dryers are not covered by the ENERGYGUIDE labelling program.

EXHIBIT D-1

U.S. CONSUMPTION TRENDS
(1972-1982)
(KWH/MO)

	1972	1978	1979	1980	1981	1982	Percentage Decline Since Pre-1978
Refrigerators	157.4	122.0	-	108.1	99.2	98.7	37%
Freezers*	156.6	115.1	-	105.2	101.3	101.2	35%
Dishwashers*	144.3	-	111.0	-	99.5	-	31%
Clothes Washers*	136.2	-	95.8	-	89.8	-	34%
Clothes Dryers*	92.0	86.5	-	85.3	-	-	7%
Electric Range	-	-	-	61.5	-	-	N.A.

Source: AHAM, (Sales Weighted Average Consumption Values), Peat Marwick Analysis

* Converted to Canadian equivalent consumption.

N.A. Data Not Available

ENERGY SAVINGS

Substantial energy savings have been achieved in the U.S. during the life of the ENERGYGUIDE program. The energy consumption trends for selected appliances are shown in Exhibit D-1, opposite. Comparable Canadian consumption data are shown in Exhibit D-2, overleaf.

Refrigerators

The energy consumption decline of refrigerators in Canada mirrors the decline which took place in the United States. Throughout the 1978-1982 period, U.S. refrigerators were more energy efficient than Canadian refrigerators. U.S. sources have indicated that all U.S. refrigerator manufacturers have converted to foam insulation, which provides higher insulating values than fibreglass. Canadian sources indicate that the Canadian conversion to foam insulation will not be complete before the end of 1986.

Freezers

Freezer efficiencies have dramatically improved in both Canada and the U.S. Canadian freezer consumption values have tended to be lower than American freezer consumption levels for several reasons:

- At least 80% of U.S. freezers are upright freezers which are inherently more energy consuming. U.S. homes often have no basements necessitating the purchase of upright freezers to conserve floor space.

- Canadian freezer manufacturers offer freezers with higher average freezer walls thicknesses than are offered to U.S. consumers resulting in lower average energy consumption values for Canadian freezers.

EXHIBIT D-2

CANADIAN CONSUMPTION TRENDS
(1972-1982)
(KWH/MO)

	Pre-1979	1980	1981	1982
Refrigerators	138.4	134.7	121.5	116.9
Freezers	113.2	81.9	74.5	71.4
Dishwashers	137.3	137.3	103.0	101.5
Clothes Washers	143.1	143.1	119.7	100.1
Clothes Dryers	96.8	96.8	96.9	96.7

Source: Peat Marwick Analysis (see Appendix E)

Dishwashers

The improvement in dishwasher efficiencies in Canada mirrors the improvements achieved in the U.S. The current energy consumption of dishwashers in Canada is very close to that achieved in the U.S.

Clotheswashers

The energy consumption of clothes washers has declined both in Canada and in the United States. The decline mirrors societal shifts in both countries to lower hot water consumption. The decline in U.S. consumption has been greater than that achieved in Canada due to a greater acceptance by U.S. consumers of the use of the cold water rinse cycle.

Clothes Dryers

The U.S. energy efficiency of clothes dryers would appear to be higher than for Canadian clothes dryers. The difference may however be a result of different test standards in each country. The rate of improvement in the U.S. was 1.3% between 1978 and 1980. U.S. officials claim that no further energy efficiency improvements have taken place.

U.S. EXPERIENCE IN APPLYING NEW TECHNOLOGIES TO APPLIANCES

Refrigerators/Freezers

In the U.S., manufacturers make product line changes every ten years when the tooling dies need replacement. Because of the high cost of tool-

ing, manufacturers are reluctant to implement changes at a rapid rate. The manufacturers are profit motivated and usually insist on a 2-3 year payback on design changes.

The U.S. Department of Energy has funded several projects to develop energy efficient refrigerators. The Department has also funded the development of very high efficiency compressors. While many technologies are available to reduce the energy consumption of refrigerators and freezers, many of the new technologies are not cost effective.

Dishwashers

Reducing energy usage in dishwashers is a problem of reducing hot water usage. Certain technical problems exist. The minimum water temperature required to melt animal fats is 140°F and the minimum water temperature required to sterilize dishes is 110°F. For these reasons, it is impractical to reduce the water temperature below these levels.

U.S. Department of Energy studies have shown that, considered from a system view, total household energy requirements can be reduced if hot water temperature can be reduced to 120°F from 140°F. The hot water requirements of dishwashers can be met by incorporating a water temperature booster to dishwashers.

Ranges

The U.S. Department of Energy funded a project at Purdue University in 1981 to develop an energy efficient oven. The project team at Purdue developed a bi-radiant oven which used 50% less energy than standard electric oven. The energy reduction was achieved through a higher oven efficiency and a reduced cooking time. While the anticipated cost of the bi-

radiant oven was comparable to that of a microwave oven, no U.S. manufacturers have expressed an interest in manufacturing this oven.

The Department of Energy is also funding advanced insulation research. Current insulation for ranges has an insulating value of about R2 per inch. The research efforts are examining various insulation technologies and are hoping to achieve insulation values of R10-R15 per inch by 1990.

The assessment of all experts is that without improved insulation, the energy efficiency of current ranges will not improve.

Dryers

No new technologies are available to reduce the energy consumption of dryers at an economic price.

Great savings in the energy consumption of dryers could be achieved if the hot air could be recycled. The humidity in the hot air can be easily removed. Removing lint, however, poses extremely difficult technical problems which have remained unsolved.

The U.S. Department of Energy Study, "Energy and the Laundry Process", April 1980, indicates that the the lowest combined energy cost for a clothes wash followed immediately by the use of a dryer is where the clothes washer uses a cold wash/warm rinse cycle.

SOURCES

Individuals Interviewed

Paul Roman, Vice President Marketing and International, Association of Home Appliance Manufacturers, Chicago.

Ronald J. Fiskum, Program Manager, Technology and Consumer Products Branch, Department of Energy, Washington.

James Mills, Bureau of Consumer Protection, Federal Trade Commission, Washington.

Tom Maronick, Program Manager, Evaluations, Department of Energy, Washington.

Mike McCabe, Program Chief, Technology and Consumer Products Board, Department of Energy, Washington.

Literature Reviewed

1. W.P. Levins, Energy and the Laundry Process, United States Department of Energy, Oak Ridge National Laboratory, April 1980 (ORNL/CON-41).

2. Alan D. Davies et al, Household Appliance Usage Data, National Bureau of Standards, prepared for the Department of Energy, February 1980 (NBSIR 80-1994).

3. Consumer Products Efficiency Standards - Economic Analysis Document, U.S. Department of Energy, March 1982 (DOE/CE-0029).

4. Consumer Products Efficiency Standards - Engineering Analysis Document, U.S. Department of Energy, March 1982 (DOE/CE-0030).

5. Supplement to March 1982 Consumer Products Efficiency Standards - Engineering Analysis and Economic Analysis Documents, U.S. Department of Energy, July 1983 (DOE/CE-0045).

APPENDIX E
ANALYSIS OF ENERGUIDE DIRECTORIES

To determine the actual (historical) energy consumption of major appliances while the Energuide Program was in place, the only authoritative source for energy consumption values for appliances is the published Energuide Directories which provide the tested energy efficiencies for each manufacturers' appliance models. While the Energuide ratings may contain hidden biases (energy consumption is measured in standard test conditions - not in actual use, and the test procedures and standards are continually being reviewed), the ratings are nevertheless considered the most unbiased energy consumption ratings available. They are the only comprehensive source of standardized consumption data.

ACTUAL ENERGY CONSUMPTION

The Energuide ratings for appliances appear in the Energuide Directories published by the CSA for CCAC. Energy consumption ratings have been published for the following appliances for the following years:

Appliance	Years Energuide Available
Refrigerators	1979 - 1983
Freezers	1980 - 1983
Dishwashers	1981 - 1983
Clotheswashers	1981 - 1983
Electric Ranges	1981 - 1983
Electric Dryers	1982 - 1983

CAMA would not release detailed sales information for each manufacturers' appliance models but could provide sales data for market subsegments (see

EXHIBIT E-1 (Continued)

ACTUAL AND ESTIMATED ENERGUIDE RATINGS
FOR MARKET SUB-SEGMENTS

DISHWASHERS

	1978	1979	1980	1981	1982	1983
Average	143.1	143.1	143.1	119.7	100.1	104.1

CLOTHES WASHERS

Sales Weighted Avg.	137.3	137.3	137.3	103.0	101.5	99.3

ELECTRIC RANGES

30" Self Clean	67.5	67.5	67.5	67.0	67.5	67.5
30" Regular	70.0	70.0	70.0	66.7	66.2	67.3
24" Regular	61.3	61.3	61.3	61.2	61.3	61.2

ELECTRIC DRYERS

Timed	91.3	91.3	91.3	91.3	91.2	91.1
Auto-Temp	100.4	100.4	100.4	100.4	100.2	99.8
Auto-Moisture	91.1	91.1	91.1	91.1	91.1	91.1

EXHIBIT E-1

ACTUAL AND ESTIMATED ENERGUIDE RATINGS
FOR MARKET SUB-SEGMENTS

REFRIGERATORS

Volume(Cu.Ft.)	1978	1979	1980	1981	1982	1983
Manual Defrost						
(8.5	55.0	55.0	55.0	42.0	42.3	42.3
8.5-9.4	55.0	55.0	55.0	55.0		
9.5-10.4	54.3	54.1	53.9	56.0	55.5	53.8
10.5-11.4	64.1	62.0	60.0			
11.5-12.4	58.6	57.6	56.6	61.5	60.6	57.7
12.5-13.4	60.6	59.3	58.0	64.3	63.1	59.7
13.5+	98.8	97.6	98.8	86.0	85.8	86.0
Other 1 Dr						
(13.5	87.0	87.0	87.0	87.0	87.0	80.3
)13.5	91.0	91.0	91.0	82.0	80.4	79.4
2-Dr Frost Free Top Freezer						
(13.5	142.4	142.0	142.4	132.4	127.8	117.1
13.5-14.5	161.5	148.2	136.0	132.9	128.9	112.1
14.5-15.49	164.0	160.6	157.3	134.3	124.5	124.0
15.5-17.5	174.7	167.4	160.4	137.1	128.3	126.5
)17.5	137.0	136.9	137.0	136.9	130.5	126.3
Frost Free, Side x Side						
(17.5	176.2	176.2	176.2	155.2	119.0	
17.5-19.5	202.7	193.9	185.5	163.4	136.3	134.7
)19.5	160.5	156.0	160.5	146.2	151.1	148.1

FREEZERS

	1978	1979	1980	1981	1982	1983
Chest Freezer						
(14.0	93.0	79.1	65.2	61.0	62.0	56.2
14-17.99	111.0	96.6	81.5	76.9	74.5	72.5
18-22.9	141.0	120.4	99.7	89.5	94.0	75.9
)23.0	150.0	137.0	116.1	106.0	105.3	90.4
Upright Freezer						
(14.0	132.0	122.2	112.3	104.2	88.0	82.0
14-17.5	164.1	150.6	137.0	126.0	109.4	104.3

Exhibit C-2). Energuide ratings were estimated, using the Energuide Directories, for the market subsegments for which CAMA could provide data. The historical Energuide ratings are shown in Exhibit E-1, opposite, along with estimates of pre-Energuide energy usage.

BASE (1978) ENERGY CONSUMPTION VALUES

There are no definitive energy consumption ratings for labelled appliances prior to their inclusion in the Energuide Program. Estimates of the base energy consumption in 1978/79 for each appliance have been constructed based on trends in available data and information obtained from other sources.

Refrigerators

The percentage decline in energy consumption of refrigerators from 1978 to 1979 was assumed equal to the percentage decline between 1979 and 1980. Where the energy consumption of refrigerators for a market segment was higher in 1980 than in 1979, the 1978 energy consumption value was assumed to be the energy consumption in 1980.

Manual Defrost

The estimated consumption of 11.5 - 12.5 cu. ft. manual defrost refrigerators for 1978 is 58.6. The October, 1981 CAMA (R. Lane) report claimed the energy consumption for an unimproved manual defrost refrigerator with fibreglass insulation was 60 kwh/mo. in 1978. Since some manual defrost refrigerators had foam insulation, which lowers the energy consumption rating, the estimated energy consumption values for manual defrost refrigerators were accepted.

Other One-Door

No changes in the energy efficiencies of other one-door refrigerators occurred between 1979 and 1980. Therefore, it was assumed that none occurred between 1978 and 1979.

Two-Door Frost-Free Top Freezer

The estimated value of 164 kwh/mo. for a 15 cu. ft. refrigerator agrees exactly with the estimated consumption provided in the CAMA report (R. Lane, 1981). The CEA report (R. Drapkin, 1981) estimated an energy consumption of 133 kwh/mo. for a 16 cu. ft. frost-free refrigerator. The CEA rating appears too low since it does not fit the subsequent Energuide ratings observed, unless the rating is for refrigerators sold in 1981. The Energuide rating calculated for 1981 using the Energuide Directories is close to the value observed by the CEA.

Frost-Free Side-by-Side

The improvement from 1978 to 1979 was assumed equal to the rate of improvement between 1979 and 1980. No corroborating evidence was found to support this estimate.

Freezers

The 1981 CEA report (R. Drapkin) and the 1981 CAMA report (R. Lane) both support an energy consumption value of 108 kwh/mo. for a 12 cu. ft. chest freezer in 1978. The average Energuide rating for a 12 cu. ft. chest freezer had fallen to 71.7 kwh/mo. by 1982. Thus, the pre-1980 consumption was 1.5 times higher than in 1982.

The rate of improvement in all freezers was assumed to be equal to the rate of improvement achieved with 12 cu. ft. freezers. Therefore, the 1978 energy consumption of each chest and upright freezer size was set at 1.5 times the corresponding 1982 energy consumption level.

The large shift to foam insulated freezers prior to Energuide labelling in 1980 resulted in a dramatic drop in the energy consumption of freezers. The drop which occurred from 1978 to 1980 was much higher than the subsequent drop which occurred between 1980 and 1981. A further assumption was made that the rate of change in energy consumption occurred at a constant rate between 1978 and 1980.

Dishwashers

Assuming that the drop in energy consumption of dishwashers occurred at the same rate between 1980 and 1981, as between 1981 and 1982, the 1980 average energy consumption value for dishwashers is estimated to be 143.1 kwh/mo. This consumption value is close to the CAMA report (R. Lane, 1981) value of 140 kwh/mo. for this period. U.S. data for dishwashers, standardized to Canadian test specifications, suggest that the energy consumption of dishwashers was 144.3 kwh/mo. in the 1978/79 period (see Appendix D). Since the import penetration of U.S. dishwashers in the 1978/79 period was about 50% and because of the high U.S. ownership of Canadian firms, the base energy consumption of dishwashers was set at 143.1 kwh/mo. for the 1978 to 1980 period.

Clotheswashers

The major change occurring between 1980 and 1981 was the elimination of the hot water rinse. The elimination of the hot water rinse provides an energy consumption saving of 25% - a value supported by both the CAMA (R. Lane, 1981) and CEA (R. Drapkin, 1981) reports. Assuming that all

clotheswashers prior to Energuide labelling had a hot water rinse, the 1978 to 1980 Energuide ratings are assumed to have been 137.3 kwh/mo. This consumption value is close to the rating of 133 kwh/mo. contained in the CEA (R. Drapkin, 1981) report and to the American average (pre-1979) of 136.2 kwh/mo. reported by AHAM (see Appendix D). The energy consumption reported by CAMA of 161 kwh/mo. appears too high.

Electric Ranges

The base consumption established for electric ranges was based on the CAMA (R. Lane, 1981) report. Energy consumption data from U.S. sources (see Appendix D) and from the CEA (R. Drapkin, 1981) report are considerably different from the actual Energuide ratings calculated. The consensus reached during the study is that minimal improvements to ranges were made. Therefore, the extreme values reported in the CEA (R. Drapkin, 1981) report and from U.S. sources were not accepted. The assumed energy consumption of 70 kwh/mo. for regular ranges (non self-clean) may overstate the average energy consumption of regular ranges since it assumes none of these ranges had insulation levels comparable to those found on self-clean ranges.

The energy consumption of 24" regular ranges was assumed equal to the 1982 consumption since the 1982 consumption was higher than the 1981 consumption for this size of range.

Clothes Dryers

The efficiency improvements whch occurred between 1982 and 1983 were projected back to 1981. It was assumed that no improvements to dryers were made prior to 1981.

EXHIBIT E-2

ACTUAL AND ESTIMATED
WEIGHTED AVERAGE ENERGUIDE RATINGS

	1978	1979	1980	1981	1982	1983
Refrigerators						
Manual Defrost	62.1	60.3	59.5	56.3	60.5	58.7
Other 1 Door	87.0	88.5	89.4	83.9	82.4	79.7
2 DR FF Top Freezer	161.5	157.5	152.3	134.8	127.4	122.1
FF Side x Side	194.5	188.2	179.5	161.3	137.3	135.5
Weighted Average	138.4	138.2	134.7	121.5	116.9	115.1
Freezers						
Chest	118.1	92.7	77.6	70.4	68.2	62.1
Upright	149.3	137.5	125.6	116.4	99.6	94.4
Weighted Average	113.2	96.4	81.9	74.5	71.4	65.0
Dishwashers	143.1	143.1	143.1	119.7	108.1	104.1
Clothesmashers	137.3	137.3	137.3	103.0	101.5	99.3
Electric Ranges	67.7	67.9	68.0	67.8	63.3	66.5
Electric Dryers	96.8	96.8	96.8	96.9	96.7	96.7

The CEA (R. Drapkin) report stated that the average dryer consumed 83 kwh/mo., an energy consumption considerably lower than was subsequently observed. U.S. data standardized to Canadian test standards would indicate a monthly consumption of 85.3 kwh/mo. for an average electric dryer. These values are clearly not representative of Canadian efficiencies prior to 1981.

AGGREGATION OF DATA

To arrive at estimates of historical energy consumption characteristics ("Energuide Ratings") for the four refrigerator types considered, the two freezer types and for dishwashers, clotheswashers, ranges and dryers, the market subsegment shares in each appliance category provided by CAMA (see Exhibit C-2), were combined with the more disaggregated Energuide ratings shown in Exhibit E-1 to arrive at the estimated and actual Energuide ratings shown in Exhibit E-2, opposite.

APPENDIX F
TECHNOLOGY STUDY

New technologies have the potential to bring major energy efficiency improvements to home appliances. Most new or existing technologies that could be applied to major appliances are not cost effective. Compressors and insulation, which are mainly applicable to refrigerators and freezers, are undergoing significant technological change. The impact of these changes promise significant energy savings to consumers. Several manufacturers and experts were interviewed to develop an understanding of the impacts of the changes on energy efficiencies. This understanding was useful in developing scenarios of what the future and past energy consumption patterns would have been.

COMPRESSOR DESIGN

Major improvements have occurred in compressor efficiencies since the beginning of the Energuide program resulting from a world-wide push to increase compressor efficiencies for use in major appliances. The range of comments from experts was:

- The Energy Efficiency Ratio (EER) expressed in BTU/watt increased as follows:
  - pre-1978: 3.0 - 3.2
  - current: 4.2 - 4.3
  - future (2-5 years): 5.0.

  The use of compressors with higher EER's in refrigeration appliances results in lower Energuide ratings for these appliances.

- Another manufacturer stated that the following Energy Efficiency Ratios were typical of his products:

  - pre-1981: 3.6
  - current (1984): 4.0
  - 1987: 4.5.

- Some experts predict that there will be a complete change to the current high efficiency motors by 1985.

- The high efficiency motors introduced in 1981 were introduced at an identical price to the older, lower efficiency compressors of similar capacity.

- One manufacturer stated that compressor efficiency represented 80% of the factors establishing energy efficiency in refrigerators.

INSULATION

A major shift from the use of fibreglass insulation to poly-urethane foam insulation has taken place. The range of comments expressed was as follows:

- The effect of the Energuide program was to speed the shift from fibreglass to foam insulation. The shift was, however, inevitable.

- Experts disagree on the extent the industry has shifted from fibreglass to foam insulation. One expert claims that about 15-20% of freezers and refrigerators were using foam insulation in 1978/79, that the proportion had increased to

50-80% by the end of 1983, and that the shift will continue for another 4-5 years. Another expert claims that the shift is now essentially complete.

- One expert stated that all freezer chests, side-by-side refrigerators and top-of-the-line 2-Door Frost-Free Top Freezers have converted to foam insulation. However, the expert felt that most single-door manual defrost refrigerators were still using fibreglass insulation.

- Experts have stated that the use of foam insulation is the only way to get higher efficiency to match the competitors' products. The R value of foam insulation (7) is more than twice that of fibreglass insulation (2.5) allowing manufacturers to reduce the thickness of the walls and yet maintain the R factor at a similar or higher level.

- One expert stated that refrigerator doors are still insulated with fibreglass. The expert claimed that foam insulation accounts for 50% of all insulation installed and by the end of 1986, the conversion to poly-urethane foam will be essentially complete.

- Experts have stated that a high capital investment was required to convert to foam insulation. Some sources have indicated that the required investment was in the order of $1-4 million for each plant.

- Some manufacturers have contended that they were shifting to foam when the shift was cost-effective and that Energuide was only a factor in the decision.

- Some manufacturers of freezers stated that the manufacturers would have shifted to foam insulation for marketing reasons or if they did not convert, they would have discontinued freezer manufacturing.

- Some of the economic reasons (not Energuide) stated for shifting included:

  - foam insulation installation is less labour-intensive and easier to accomplish

  - foam insulation provides a more structurally rigid box resulting in lower shipping damage and increased stacking heights in warehouses resulting in better warehouse utilization

  - reduced service costs

  - reduced problems with humidity in the walls

  - permitted smaller compressors to be used resulting in lower component costs

  - permitted the use of a lower gauge steel.

- Experts do not expect dramatic future efficiency improvements in foam insulation.

- Officials in the U.S. Department of Energy believe that the research they are funding will lead to a breakthrough in insulation materials. A new insulation offering an insulating value of at least R15 for refrigerators and R10 for ranges may be available in the early 1990's.

SOURCING CHANGES

Compressors

The consensus among experts is that the shift to foreign produced (Danfoss, Embraco, Matsushita) compressors would have taken place even if the Energuide program were not in place. The foreign produced compressors are significantly cheaper than the equivalent compressors produced in Canada. This view was confirmed by Tecumseh, a major Canadian producer. One expert indicated that had Energuide not existed, Tecumseh may have been able to keep one half of the sales it lost to foreign suppliers.

Insulation

A significant shift took place from fibreglass insulation produced by Fiberglas Canada (Sarnia) to foam insulation; the foam chemicals are produced by Mobay Chemicals (Bayer), PPG Industries and General Latex. The Canadian value-added appears to be lower than previously.

Although a shift to foam insulation would have taken place, Energuide has had an impact on the timing of the shift. The differential impact of the Energuide program is difficult to measure and is not known. One expert claims that Energuide sped up the introduction of poly-urethane foam insulation by, at most, three years.

SUPPLIERS INTERVIEWED

Bill Miller, Sales Manager, Coil and Appliance Finish, PPG Industries (Canada)

Brian Duff, Sales Manager, Mobay Chemical Corporation (Bayer), Toronto, Ontario

Brian Collins, Engineering Support Division, Product Engineer - Home Appliances, Matsushita, U.S. Office - New Jersey

Ron Brodawka, National Sales Manager, Danfoss (Canada)

W.E. Shadwick, V.P. Finance, Tecumseh, London, Ontraio

Rob Webster, Technical Service, General Latex

APPENDIX G
APPLIANCE CASE STUDIES

It was originally planned that case studies of two appliances would be undertaken. It became clear during the engagement that it was both possible and appropriate to deal with all six appliances. Thus, a case study of each major appliance was conducted, primarily to obtain information on the hypothetical energy use, both past and future, but also to obtain information on actual sales and manufacturing costs. The information was obtained through a series of interviews with industry experts.

The information collected on the hypothetical energy use of appliances formed a significant basis of the energy consumption scenarios constructed for each major appliance. These scenarios are to be found in Sections II to V.

A detailed analysis of actual and hypothetical sales is found in Appendix C, and a detailed analysis of the actual energy use of the appliances is found in Appendix E. A discussion of manufacturing costs is found in Section VIII.

G.1 REFRIGERATION PRODUCTS

To improve the Energuide ratings of refrigeration appliances, efforts have been primarily directed at reducing the heat gain losses through improved insulation and through improved compressor (heat pump) efficiencies.

G1.1 REFRIGERATORS

Actual Energy Use

- According to one spokesman, 2 of 3 largest manufacturers of refrigerators were still using fibreglass insulation until recently.

According to some experts, the Energuide program has had the following benefits:

- has brought improved standards of manufacturing and measurement of energy consumption;
- has spurred a definite effort by manufacturers to improve efficiencies.

Hypothetical Energy Use

Past - No Energuide

The range of expert opinion was as follows:

- Manufacturers would have pursued low-cost design changes. Manufacturers would not have done much as they lacked design capability in-house. Manufacturers did not know what the energy consumption of their appliances was.
- Compressor improvements and other low investment changes would have been made. High investment changes such as foam insulation probably would not have been introduced.

- Improvements would have occurred anyhow and would have tracked what actually occurred.

- Some manufacturers have felt that energy efficiency is not a merchandisable benefit for refrigerators.

- Manufacturers changed to higher efficiency compressors because of supply problems from a Canadian supplier. Foreign suppliers had a more efficient unit than the Canadian supplier.

- Energy efficiency improvement would have been 1/2 of what was achieved.

Future - No Energuide

The range of expert opinion expressed was as follows:

- Improved compressors will not likely be incorporated into refrigerators if more expensive than the current compressors.

- Experts disagree on the scenario of future improvements. The opinions range from:

  - slower rate of improvement, 40% of what would have been achieved had Energuide continued

  - a 15% initial drop in efficiency

  - the worst case - efficiency would stay flat.

Future - With Energuide

The range of expert opinion was as follows:

- A 10-15% improvement - 10% from compressors and 5% from controls.

- A possible Japanese entry into the market may affect the timing of design changes. One spokesman indicated that an improvement of 10-15% is possible.

- Improvements to manual defrost refrigerators will be less than for frost-free refrigerators.

- Forecast improvement in 2-Door Frost-Free Top Freezer - 10-20% in next five years.

- Side-by-Side Frost-Free refrigerators are less energy sensitive but improvements will parallel those of the 2-Door Frost-Free refrigerators.

G.1.2 FREEZERS

Actual Energy Use

The range of expert opinion expressed was as follows:

- The freezer market is highly competitive and energy efficiency is one of the few demonstrable advantages.

- The energy consumption reduction has reached its practical limit and may have exceeded it (i.e., product performance has deteriorated).

- The Energuide program has improved freezer reliability and efficiency.

- Having the energy efficiencies published forced the manufacturers to pay attention to energy efficiency.

- The costs being passed on to consumers may exceed the benefit obtained.

Hypothetical Energy Use

Past - No Energuide

The range of expert opinion was as follows:

- The move to foam was inevitable - fibreglass was doomed for freezers.

- Two manufacturers stated that the freezer manufacturers would have set up their own energy tests to show that their products were energy efficient but admitted their programs would not be as effective as the Energuide program.

- Compressor efficiencies would have improved anyhow (10% in 1981) and at least one Canadian manufacturer would have competed on the basis of energy efficiency.

- Would not have introduced a 2 3/4" or 3" thick freezer chest (25% saving in Energuide rating) as majority of freezer chests sold in Canada and the U.S. are 2" thick.

- The move to energy efficiency was inevitable.

Future

- Improvements are getting more difficult - diminishing returns.
- In the next 1-2 years, 5-10% improvement from compressors.
- With Energuide, pressure would exist to adopt the higher efficiency compressors coming on the market.
- Not much further to go.
- Without Energuide, product performance would not decline because the investment that was made to reduce energy efficiency would not be removed. However, there would be a marketing shift to thinner walled freezers.

G.2 WASHING PRODUCTS

Major reductions in Energuide ratings have been achieved primarily through a reduction in hot water usage.

G.2.1 Dishwashers

About 90% of the energy consumption in dishwashers comes from the use of hot water. The manufacturers' efforts have therefore been directed primarily at reducing hot water usage.

Actual Energy Use

The following was the range of expert opinion expressed:

- Manufacturers played with the normal cycle to obtain lower Energuide ratings.
- Manufacturers reduced the number of fills from 7 or 6 to 5 or 4, altered the amount of hot water introduced with each cycle, and increased the washing time per fill.
- Some manufacturers substituted more expensive motors.
- The Canadian reductions followed the American reductions in hot water usage.
- The hot water temperature has remained at 140°F. Lower water temperatures seriously affect dishwasher performance.
- Considerable redesign of dishwashers has taken place.
- There is current industry dissatisfaction with the performance of dishwashers. Dishwashers do not clean as well as they should.

Hypothetical Energy Use

Past - No Energuide

The following range of expert opinion was expressed:

- The manufacturers would not have reduced energy consumption as much.

- Would have achieved 50% of what actually occurred because of U.S. work on dishwashers. U.S. technology is available to the large Canadian manufacturers.

- In the 1981-83 period, U.S. imports were between 15% and 24%. Since the U.S. appliances were becoming more energy efficient, this would have had a beneficial impact on the overall energy efficiency.

Future - With Energuide

The following expert opinion was expressed:

- A more efficient motor might be introduced. This will have little effect on the Energuide rating but will possibly improve dishwasher performance.

- Most experts believe that not much more energy efficiency gains are to be achieved. The experts see diminishing returns. The future gains will be very small.

- Some manufacturers are looking at new pumps. Their objective is to get the water cleaner during each cycle to reduce the number of water changes.

- One manufacturer had an Energuide rating of about 130 before the program, now has a rating of about 90 but will go back to a rating of about 125 because of a deterioration in the washing ability of his dishwasher.

Future - No Energuide

The range of expert opinion was as follows:

- The manufacturers have made an investment to reduce energy consumption of dishwashers; they will not return to the original efficiency levels.

- Some experts predict a 10% drop in efficiency because more heat/hot water will be used in the wash cycles.

- Some manufacturers expressed dissatisfaction with the convection drying method. They would move to heat assisted drying.

- U.S. imports are expected to continue at a level of 24-26%. Since the U.S. manufacturers do not ship a different model to Canada, and given a continued U.S. ENERYGUIDE program, the efficiency of U.S. produced dishwashers would not decline.

G2.2 CLOTHES WASHERS

About 95% of the energy consumed in clothes washers is from the hot water used. Manufacturers have concentrated on reducing the hot water used.

Actual Energy Use

The range of expert opinion was as follows:

- Manufacturers have not made specific design changes to improve the washing machine product but have improved the Energuide ratings by reducing the number of selections available to consumers.

- Clothes washers manufactured prior to 1981 offered a hot rinse cycle. At the time of the first Energuide testing in 1981, the hot rinse cycle was eliminated from most machines, resulting in a reduction in the Energuide ratings of about 25%.

- In 1980 and prior, many washers had six temperature selections as follows:

Wash Cycle	Rinse Cycle
hot	hot
warm	warm
hot	warm
cold	cold
warm	cold
hot	cold

Most machines introduced in 1981 eliminated the hot rinse cycle. Furthermore, some machines introduced in 1982 eliminated the warm rinse cycle. According to manufacturers, clothes washers without warm rinse cycles have met some consumer resistance.

- The permanent-press cycle used to have a double cool down cycle. Current machines have only one.

- One expert attributed a shift from a hot-wash-warm rinse pattern to a warm-wash - cold rinse pattern to a societal change to less hot water usage.

- The change in energy usage mirrors the change that took place in the U.S.

Hypothetical Energy Usage

Past - No Energuide

The expert opinion was as follows:

- Some experts stated that the hypothetical performance would have tracked equally with what happened.
- There is continuing pressure to reduce the temperature and use of hot water for safety reasons.
- Not all of the washing selections would have been eliminated. The hot rinse option may have been phased out over a three-year period instead of one.

Future

The expert opinion included the following:

- Continuing pressure on the industry to reduce the temperature of hot water for safety reasons.
- To reduce the Energuide ratings appreciably, major breakthroughs in detergent washing performance are required.
- If Energuide is discontinued, nothing will happen to the energy efficiency.

G.3 ELECTRIC RANGES

Actual Energy Usage

The expert consensus was that there has been almost no improvement.

Hypothetical Energy Usage

Past - No Energuide

The expert consensus was that no improvements would have been made.

Future

The range of expert opinion was as follows:

- Not much improvement is possible.
- Some improvement in efficiency in the order of 5 KWH/mo. due to safety reasons is foreseen. CSA limits on exterior surface temperatures are about to be lowered to reduce the burn hazards of ovens.
- Some experts do not see energy efficiency improvements without a serious deterioration in product performance.
- Improvements in energy efficiency will be driven by safety not energy efficiency.

G.4 ELECTRIC DRYERS

Actual Energy Usage

The range of expert opinion was as follows:

- Many experts contend that labelling of dryers has been ineffective.
- All experts agree that minimal improvements in dryer efficiences have taken place.

Future - Without Energuide

The expert consensus is that no improvements will be made.

Future - With Energuide

The range of expert opinion is as follows:

- Most experts contend that there will be no further improvements in the energy efficiency of dryers.
- As dryers are not labelled in the U.S., there is not much effort being placed on improving dryer efficiencies.
- An expert has stated that small efficiency gains could be achieved by optimized airflow and heat input. Dryers are now near peak efficiency and major reductions in energy consumption are not economic.

INTERVIEWS

Manufacturers and Manufacturer Representatives

Roger I. Lane, Chairman, CAMA Technical Committee

Marc-Andre Berard, Product Manager, Laundry Division, CAMCO

Mr. Dall, National Sales Manager, Hobart Canada

Ernie Allen, Marketing Manager, Kenmore Products, Inglis

Bruce Smith, Branch Manager, Admiral, Inglis

Clive Deacon, Senior Product Engineering - Washers, Inglis

Mark MacIntosh, Product Engineer - Refrigerators and Dishwashers, Inglis

Cam Thomson, Product Manager - Admiral Brand, Laundry and Dishwashers, Inglis

T. Cousineau, V.P. Manufacturing, W.C. Wood

P. Charne, Branch Administration & Secretary Treasurer, Maytag (Canada)

Fred Collins, Export Manager, Maytag, Newton, Iowa

Doug Wringer, Manager Product Test Lab, Maytag, Newton, Iowa

Jean-Marc Leger, V.P. Engineering, WCI

Eric Smart, V.P. Engineering, Franklin Manufacturing (WCI)

Kriss Kumra, V.P. Engineering, General Freezer

John Bull, President, General Freezer

Alda Murphy, Manager, Consumer Products Division, EEMAC

Sundar Raj, Manager, Statistics and Economic Information, EEMAC

Lori Janssen, Supervisor, Data Centre, EEMAC

Government and Other

Saul Stricker, Manager, Product Development and Load Management, Ontario Hydro

Steve Mastoris, Supervisor, Residential and Commercial Analysis, Ontario Hydro

Roy Patterson, Project Manager - Energuide Program, CSA

R. Haighton, CSA

John Ryan, Department of Energy, Washington

Ron Fiskum, Department of Energy, Washington

Mr. Douglas, CEA

Mike Bell, Ontario Hydro Research Labs, Ontario Hydro

Lorne Maher, Electronics and Aerospace Branch, Department of Industry, Trade and Commerce

APPENDIX H
RETAIL INTERVIEWS

Several large retailers of major appliances were interviewed to assess the impact of the Energuide Program on marketing activities and to determine the extent to which the Energuide Program has imposed additional costs.

USE OF ENERGY EFFICIENCY INFORMATION IN MARKETING ACTIVITITES

The following views illustrate the range of comments:

- Of the chains interviewed, only one promotes Energuide ratings for Freezers. The Energuide ratings for other appliances were not promoted.

- The retailers find it difficult to sell KWH/mo since this is not as tangible as dollars and cents.

- Energy efficiency is not promoted. It is not discussed with customers at the point-of-sale unless the issue is raised by the customer.

- The large chains train their salesmen to understand the energy efficiency ratings of the appliances they sell.

- Most chains do not advertise the energy efficiencies of the major appliances (white goods) they sell. Only one firm indicated that it used energy efficiency ratings in its advertisements.

- Some of the major chains use the Energuide directory to compare their brands with other brands - both for buying and selling purposes.

- One large chain has indicated that they used to be active in promoting energy efficiency at the point-of-sale but are not active now.

LEVEL OF INCREASED COSTS ASSOCIATED WITH THE ENERGUIDE PROGRAM

Most chains indicated that they incurred no additional costs as a result of the program. One chain indicated that the Energuide labels get torn off by children leading to a premature markdown of appliances to clear them. Another chain stated that it had to mark down some appliances on two occasions to make way for new models that were more energy efficient. One chain indicated that is costs were limited to the distribution costs of shipping the Energuide directories to all its stores.

INDIVIDUALS INTERVIEWED

Joe Colucci, National Merchandising Manager, Sears
Gerald Connor, National Sales Manager, Sears
Abbey Leon, Appliance Buyer, Leon's
Eric Place, Woolco
Keith Keindal, National Sales Manager, Major Appliance Group, The Bay
Norm Baker, National Commodity Manager for Beaumark Appliances, Simpson's
George Nohof, Buyer, Woodwards
Larry McFadden, Sales Supervisor, Woodwards
Bill Friend, Merchandise Sales Manager, Eaton's
Ken Ramsey, National Sales Manager, Beaumark, Simpsons's
Nigel Lee, Sales Manager, The Brick Warehouse (owner's of Stuarts)

EXHIBIT J-1

REFRIGERATORS

Energy Consumption Scenarios

			1985	1986	1987	1988	1989
Sales - Projected ('000)							
Refrigerators			532	548	565	578	592
Energy Consumption Scenarios (KWH/mo.)							
	LOW	I	107.3	103.6	100.0	96.6	93.3
		II	107.9	107.6	107.3	106.9	106.6
	BASE	I	107.3	103.6	100.0	96.6	93.3
		II	116.3	114.7	113.2	111.6	110.1
	HIGH	I	101.9	96.8	92.0	87.4	83.0
		II	116.3	114.7	113.2	111.6	110.1

	NET PRESENT VALUE SOCIAL DISCOUNT RATE			GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)				
	5%	10%	15%					
LOW	282.65	169.45	143.18	3.7	26.0	48.9	71.7	94.9
BASE	377.48	325.07	282.91	57.5	73.1	89.0	104.2	119.6
HIGH	687.23	522.85	454.96	91.8	117.7	143.6	168.1	192.4

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued

APPENDIX I

METHODOLOGY FOR ESTIMATING ENERGY COST SAVINGS GENERATED BY APPLIANCES

The one-time cost savings generated by appliances that save E kilowatt hours of energy per month are:

$$S = p.E.I + 7.6 \times (12\ E) \times C \qquad (1)$$

where:

S is the cost-saving at the time of purchase in $

p is the "demand factor" in watts per kilowatt-hour of monthly consumption, in watts/kwhr.

E is the amount of energy saved per month, in kwhrs/month

I is the utility's incremental capital cost in $/watt of incremental load

7.6 is the Net Present Value of one dollar operating cost incurred each year over 15 years at a 10% real discount rate[1]

C is the operating (non-capital) cost of producing one kilowatt hour of energy, in $/kwhr.

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1 The corresponding number for a 5% discount rate is 10.38 and for a 15% discount rate is 5.85.

When some of these electrical energy savings are offset by a need for increased space heating an offset factor "f" must be defined. This factor is composed of two components:

f_1 is the portion of the year in which space heating is required

f_2 is the portion of the appliance's energy consumption that is transformed into heat staying inside the home

$$f = f_1 \times f_2 \qquad (2)$$

For example, if the duration of the heating season is six months, f_1 = 0.5. If a dishwasher dissipates 20 percent of its energy consumption in the form of heat within the house f_2 = 0.2 and f = 0.5 x 0.2 = 0.1.

To be precise, both I and C must be adjusted to reflect the offsets. Thus, I' and C' to be used in Equation (1) are:

$$I' = I - f_2 \times I_s \qquad (3)$$

$$C' = C - f \times C_s \qquad (4)$$

where:

I is the utilities' incremental investment required to satisfy the peak demand of the appliances (see Exhibit 12)

I_s is the incremental investment required to satisfy the peak demand of space heating (see Exhibit 13 for gas)

C is the operating cost per kwhr of producing the energy for the appliances in the "high cost scenario" and the consumer rate in the "low cost scenario" (see Exhibit 12)

C_s is the energy cost of space heating per equivalent kwhr (operating cost of production or consumer rate, as above). See Exhibit 13 for costs of gas.

"Equivalent kwhr-s" are:

6.5 kwhr-s per m^3 of gas
7.0 kwhr-s per litre of oil.

The variables I, I_s, C and C_s represent mixtures of several forms of fuel. I_s and C_s are determined by the percentage of homes heated by electricity, gas or oil in a province (Exhibit 14). I and C are determined by the mixture of fuels used in the operation of the appliances. It is 100% electricity for refrigerators, freezers, ranges and dryers. It is about 20% "direct" electricity (not hot water) for dishwashers and 5% direct electricity for clotheswashers. The costs of the remaining percentages for the latter two appliances are calculated by considering the appropriate mixture of fuels used for water heating.

APPENDIX J

SENSITIVITY ANALYSIS OF FUTURE GROSS ENERGY SAVINGS

This Appendix explores the sensitivity on future gross energy savings of changes in assumptions with respect to the actual energy savings attributable to a continuation of the Energuide program to 1989.

The base case energy savings estimates for each major appliance developed in Sections II to V are intended to represent the 50th percentile (or median) of the possible range of estimates of energy savings attributable to the Energuide Program. Low and high estimates, which have also been developed on the same basis as the base case, are intended to represent the 5th and 95th percentiles of possible estimates respectively, i.e., we are 90% confident that the true estimate lies between them. The low and high estimates are described below. In each case, Scenario III is unchanged from the Base Case.

The base case gross energy savings presented in this Appendix differ slightly from the gross energy savings for each appliance shown in Sections II to V because of rounding.

REFRIGERATORS

The low, base and high energy savings scenarios and the associated energy consumption scenarios for refrigerators are found in Exhibit J-1, opposite.

Low (5%) Energy Savings Case

Scenario I was assumed unchanged from the base case.

EXHIBIT J-2

FREEZERS

Energy Consumption Scenarios

			1985	1986	1987	1988	1989
Sales - Projected ('000)							
Freezers			295	300	305	310	310
Energy Consumption Scenarios (KWH/mo.)							
	LOW	I	64.2	63.7	63.3	62.9	62.5
		II	64.8	65.0	55.2	65.4	65.6
	BASE	I	64.2	63.7	63.3	62.9	62.5
		II	71.3	71.5	71.8	72.0	72.2
	HIGH	I	62.9	61.6	60.4	59.2	58.0
		II	71.3	71.5	71.8	72.0	72.2

	NET PRESENT VALUE SOCIAL DISCOUNT RATE			GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)				
	5%	10%	15%					
LOW	29.11	24.65	21.10	2.2	4.5	6.9	9.4	11.7
BASE	132.31	114.67	100.77	25.2	28.0	30.9	33.8	36.2
HIGH	177.09	153.02	133.61	29.8	35.6	41.6	47.6	52.8

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued

In Scenario II, the 5% deterioration in energy efficiency was assumed not to take place. Furthermore in this Scenario, new technology was assumed to be introduced at a higher rate than in the base case. The decline in energy consumption is at a rate .5% per year lower than with Energuide in place.

High (95%) Energy Savings Case

Scenario II is unchanged from the base case. In Scenario I, Energuide is assumed to have a greater impact on the introduction rate of energy saving technology causing the energy consumption of refrigerators to fall at a rate of 5% per year instead of 3.4% per year found in the base case.

FREEZERS

The low, base and high energy savings scenarios and the associated energy consumption scenarios for freezers are found in Exhibit J-2, opposite.

Low (5%) Energy Savings Case

Scenario I is assumed unchanged from the base case.

For Scenario II, average freezer efficiencies are assumed not to drop after the discontinuation of Energuide. The deterioration in performance for freezers is assumed to take place at a rate of .3% per year versus .35% per year in the base case.

High (95%) Energy Savings Case

In Scenario I, a higher (2% per year versus .67% per year in the base case) rate of improvement is assumed because of a greater use of very high efficiency compressors than in the base case.

EXHIBIT J-3

DISHWASHERS

Energy Consumption Scenarios

			1985	1986	1987	1988	1989
Sales - Projected ('000)							
Dishwashers			274	291	303	320	332
Energy Consumption Scenarios (KWH/mo.)							
	LOW	I	103.4	103.0	102.7	102.3	102.0
		II	103.7	103.7	103.7	103.7	103.7
	BASE	I	103.4	103.0	102.7	102.3	102.0
		II	106.9	106.7	106.6	106.4	106.2
	HIGH	I	102.9	102.4	101.9	101.3	100.8
		II	106.9	106.7	106.6	106.4	106.2

	NET PRESENT VALUE SOCIAL DISCOUNT RATE			GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)				
	5%	10%	15%					
LOW	15.72	13.26	11.31	1.0	2.3	3.6	5.2	6.8
BASE	92.00	79.90	70.24	18.1	19.8	21.3	23.2	24.7
HIGH	105.20	91.20	80.02	19.8	22.2	24.3	27.0	29.3

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued

Scenario II is assumed unchanged from the base case. The lack of Energuide information is assumed to have a detrimental impact on the energy efficiencies of freezers.

DISHWASHERS

The low, base and high energy savings scenarios and the associated energy consumption scenarios for dishwashers are found in Exhibit J-3, opposite.

Low (5%) Energy Savings Case

Scenario I is assumed to be identical to the corresponding Scenario I in the base case.

In Scenario II, the initial deterioration of 5% in dishwasher energy consumption assumed in the base case is assumed not to occur. Furthermore, the 1985 to 1989 performance of dishwashers is frozen at 1974 levels.

High (95%) Energy Savings Case

In Scenario I, it is assumed that the Energuide program will cause the energy efficiency of dishwashers to improve at a higher rate (.5% per year versus .34% per year in the base case).

Scenario II is assumed unchanged from Scenario II of the base case.

CLOTHESWASHERS

The low, base and high gross energy savings scenarios and the associated energy consumption scenarios for clotheswashers are found in Exhibit J-4, overleaf.

EXHIBIT J-4

CLOTHESWASHERS

Energy Consumption Scenarios

			1985	1986	1987	1988	1989
Sales - Projected ('000)							
Clotheswashers			496	508	520	529	539
Energy Consumption Scenarios (KWH/mo.)							
	LOW	I	96.3	94.9	93.5	92.1	90.7
		II	96.5	95.1	93.8	92.5	91.2
	BASE	I	96.3	94.9	93.5	92.1	90.7
		II	96.8	95.9	94.9	94.0	93.0
	HIGH	I	95.9	93.9	92.1	90.2	88.4
		II	96.8	95.9	94.9	94.0	93.0

	NET PRESENT VALUE SOCIAL DISCOUNT RATE			GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)				
	5%	10%	15%					
LOW	8.01	6.81	5.84	0.7	1.3	1.9	2.5	3.1
BASE	37.65	31.91	27.33	3.0	5.9	9.0	12.0	15.1
HIGH	74.42	63.06	54.01	5.0	11.7	17.8	23.7	29.8

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued

EXHIBIT J-5

ELECTRIC RANGES

Energy Consumption Scenarios

			1985	1986	1987	1988	1989
Sales - Projected ('000)							
Electric Ranges			426	448	455	468	481
Energy Consumption Scenarios (KWH/mo.)							
	LOW	I	66.5	61.5	61.4	61.4	61.4
		II	66.5	61.5	61.4	61.4	61.4
	BASE	I	66.5	61.5	61.4	61.4	61.4
		II	66.5	61.5	61.4	61.4	61.4
	HIGH	I	66.3	61.2	60.9	60.8	60.6
		II	66.5	61.5	61.4	61.4	61.4

	NET PRESENT VALUE SOCIAL DISCOUNT RATE			GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)				
	5%	10%	15%					
LOW	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
BASE	0.30	0.00	0.00	0.0	0.0	0.0	0.0	0.0
HIGH	10.76	9.11	7.79	0.8	1.6	2.5	3.4	4.4

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued

Low (5%) Energy Savings

Scenario I is assumed to be identical to Scenario I of the base case.

In Scenario II, the decline in energy consumption of clotheswashers is assumed to take place at a higher rate than in the base case. The Scenario II rate of decline in energy consumption is assumed to be only .1% per year below the Scenario I rate of decline because of a heightened consumer shift to lower hot water usage.

High (95%) Energy Savings Case

In Scenario I, the decline in energy consumption for clotheswashers is assumed to take place at a higher rate than in the base case (2% per annum versus 1.5% per annum in the base case). The Energuide program is assumed to cause the societal shift to lower hot water usage to occur at a faster rate.

Scenario II is assumed to be identical to Scenario II of the base case.

ELECTRIC RANGES

The low, base and high energy savings scenarios and the associated energy consumption scenarios for electric ranges are found in Exhibit J-5, opposite.

Low (5%) Energy Savings Case

Scenarios I and II are both identical to the energy consumption Scenarios I and II of the base case.

High (95%) Energy Savings Case

In Scenario I, the average energy consumption of electric ranges is assumed to decline by .25% per year because of increased consumer shifts to more efficient electric ranges.

Scenario II is assumed unchanged from Scenario II of the base case.

ELECTRIC DRYERS

The low, base and high energy savings scenarios and the associated energy consumption scenarios for electric dryers are found in Exhibit J-6, opposite.

Low (5%) Energy Savings Case

Scenario I is assumed to be identical to Scenario I of the base case.

In Scenario II, the consumption decline for electric dryers is assumed to occur at the same rate as in Scenario I.

High (95%) Energy Savings Case

The Scenario I improvement in dryer efficiency is assumed to take place at a rate of .48% per year versus .34% per year in the base case, reflecting the higher impact of the Energuide program.

Scenario II is assumed unchanged from Scenario II of the base case.

SUMMARY

Exhibit J-7, overleaf, summarizes the impact of the sensitivities on the total gross energy saved by all appliances. It is clear from this exhibit

EXHIBIT J-6

ELECTRIC DRYERS

Energy Consumption Scenarios

			1985	1986	1987	1988	1989
Sales - Projected ('000)							
Electric Dryers			353	363	375	385	395
Energy Consumption Scenarios (KWH/mo.)							
	LOW	I	96.1	95.8	95.4	95.1	94.8
		II	96.1	95.8	95.4	95.1	94.8
	BASE	I	96.1	95.8	95.4	95.1	94.8
		II	96.2	96.0	95.7	95.5	95.3
	HIGH	I	96.0	95.5	95.0	94.6	94.1
		II	96.2	96.0	95.7	95.5	95.3

	NET PRESENT VALUE SOCIAL DISCOUNT RATE			GROSS GIGAWATT-HOURS SAVED (Annual-Incremental Before Offsets)				
	5%	10%	15%					
LOW	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
BASE	5.58	4.74	4.07	0.5	0.9	1.3	1.7	2.2
HIGH	13.23	11.22	9.61	1.1	2.1	3.1	4.2	5.3

Note: Scenarios

I = Energuide in place (Past and Future)
II = Energuide in place then Discontinued

EXHIBIT J-7

SUMMARY - GROSS GIGAWATT-HOURS SAVED
(Annual-Incremental Before Offsets)

Energy Savings Case	NET PRESENT VALUE SOCIAL DISCOUNT RATE 5%	10%	15%	1985	1986	1987	1988	1989
LOW	255.58	214.17	181.43	7.61	34.14	61.35	88.79	116.45
BASE	645.82	556.57	485.31	104.33	127.82	151.45	174.94	197.79
HIGH	987.93	858.53	748.81	149.11	190.93	232.86	274.85	314.12

EXHIBIT J-8

ADJUSTMENT FACTORS

Energy Savings Case	SOCIAL DISCOUNT RATE 5%	10%	15%
REFRIGERATORS			
LOW	0.54	0.52	0.51
BASE	1.00	1.00	1.00
HIGH	1.61	1.61	1.61
FREEZERS			
LOW	0.22	0.21	0.21
BASE	1.00	1.00	1.00
HIGH	1.34	1.33	1.33
DISHWASHERS			
LOW	0.17	0.17	0.16
BASE	1.00	1.00	1.00
HIGH	1.14	1.14	1.14
CLOTHESWASHERS			
LOW	0.21	0.21	0.21
BASE	1.00	1.00	1.00
HIGH	1.98	1.98	1.98
ELECTRIC RANGES			
LOW	N.A	N.A	N.A
BASE	1.00	1.00	1.00
HIGH	N.A	N.A	N.A
ELECTRIC DRYERS			
LOW	0.00	0.00	0.00
BASE	1.00	1.00	1.00
HIGH	2.37	2.37	2.36
TOTAL			
LOW	0.40	0.38	0.37
BASE	1.00	1.00	1.00
HIGH	1.53	1.33	1.33

N.A. Not Applicable

that there is a considerable range in the estimates of gross energy savings at the "80% level".

Adjustment Factors

To value the low and high energy savings scenarios, a set of adjustment factors was calculated. These factors were developed using the Net Present Value (NPV) calculations for each energy savings scenario found in Exhibits J-1 to J-7 for each of the three Social Discount Rates considered (5%, 10% and 15%). A table of the calculated adjustment factors for each of the major appliances is found in Exhibit J-8, opposite.

POOR

QUALITY

ORIGINAL